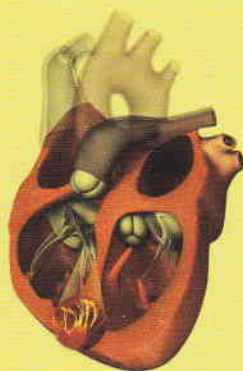
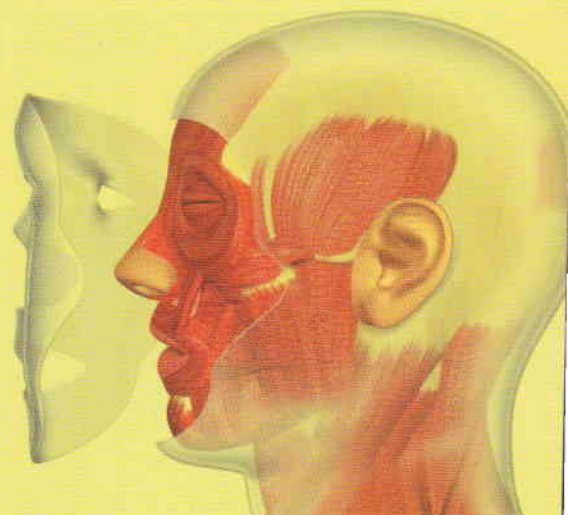
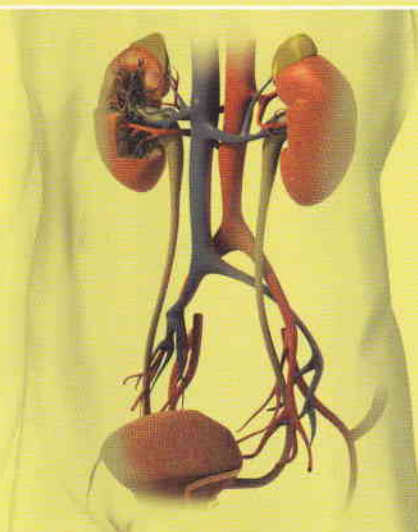


*Matary Textbook of*

# **SPECIAL SURGERY**

*Mohammed El-Matary*



**ORTHOPEDIC SURGERY  
NEUROSURGERY  
PLASTIC SURGERY  
UROSURGERY  
CARDIOTHORACIC SURGERY**

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## **Dedication**

Allah the all merciful, I beg Thee  
To accept this effort  
For the soul of my mother  
She was your gift for me

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# **Preface**

This book provides an update for medical students who need to keep abreast of recent developments. I hope also it will be useful for those preparing for postgraduate examination.

This book is designed to provide a concise summary of orthopedics, neurosurgery and plastic surgery, which medical students and others can use as study guide by itself or with readings in current textbooks, monographs, and reviews.

Summaries of relevant anatomical considerations are included in every chapter, taking into account that this book is written primarily for those who have some knowledge of anatomy, physiology, biochemistry and pharmacology.

The author is extremely grateful to all the contributors for the high standard of the new chapters, and hopes that you, the reader, will enjoy going through these pages as much as he had.

***M. El-Matary***

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# CHAPTER 1

## *Orthopedic surgery*

- General traumatology
- Upper limb fractures
- Lower limb fractures
- Bone inflammation
- Bone tumors
- Bone & joint deformities
- Congenital disorders of bones & joints
- Painful conditions

# General Traumatology

## Definitions

- **Fracture:** *discontinuity of bone.*
- **Dislocation:** disruption of the continuity of a joint. □ joint surface are no longer in continuity”
- **Subluxation:** partial disruption of the continuity of a joint. □ Joint surface are still opposed.”
- **Fracture dislocation:** dislocation together with a fracture of one or more of the bones forming the joint.

## Types of Fractures

## According to Etiology

1. **Traumatic fracture (major trauma):**
  - **Direct:** fracture occurs at the point of trauma. e.g. crush fracture.
  - **Indirect:**
    - Avulsion e.g. patella (due to separation of long process with its attached muscles as a result of sudden undue movement).
    - Angulation. - Rotation.
    - Compression □ "Burst fracture" e.g. vertebra.
2. **Pathological fracture:**
  - A minor trauma to already weakened bone by **pre-existing disease**, by a degree of stress or trauma .
  - The disease may be local e.g. metastasis or generalized e.g. osteoporosis.
3. **Stress fracture (Fatigue fractures):**
  - Fractures that occur 2ry to **repeated loads applied to the skeleton** e.g. harsh fracture in 2<sup>nd</sup> & 3<sup>rd</sup> metatarsal bones due to prolonged walking.

### According to relation to surrounding structures

1. **Closed (simple) fracture:** does not communicate with the exterior environment
2. **Open (compound) fracture:** communicates with the exterior environment or body cavity e.g. skull fracture communicating with air sinus.
3. **Complicated fracture:** there is associated damage to nerve, blood vessels or internal structure.

### According to Shape of Fracture Line

1. **Transverse** (angle  $< 30^\circ$  ).
2. **Oblique** (angle  $> 30^\circ$  ).
3. **Spiral**.
4. **Comminuted** =  $> 2$  fragments.
5. **Double level fracture or segmental fracture**.
6. **Epiphyseal separation**



Transverse



Oblique



Greenstick



Fissured



Comminuted



**According to extent**

1. Complete fracture.
2. Incomplete fracture:
  - **Fissure fracture:** incomplete fracture in **adult** bone.
  - **Greenstick fracture:** incomplete fracture in **child** (soft bones & thick periosteum.).
  - **Compression fracture.**

**According to Impaction**

1. Non-impacted.
2. Impacted:
  - A fragment is driven into the other fragment.
  - Mainly occurs in epiphyseal areas e.g. with Colles' fracture.

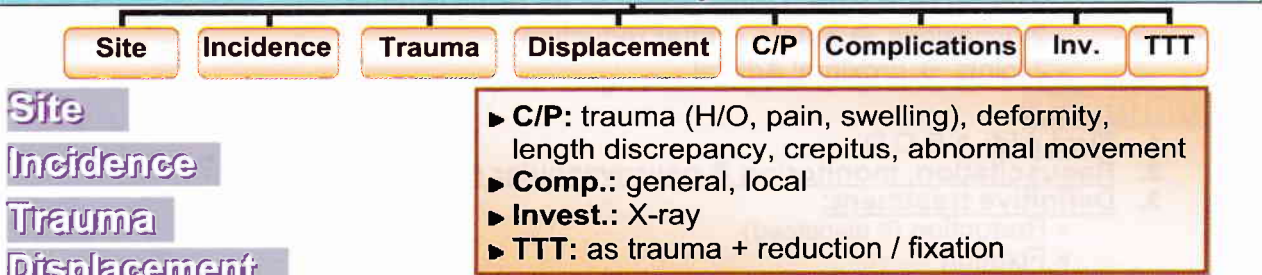
**According to stability**

1. **Stable fracture:** unlikely to displace **further**.
2. **Unstable fracture:** will continue to displace **further**, if action isn't taken to keep the fracture secure.



Greenstick fracture of the Tibia

## Scheme for Any Fracture



- Position of **distal fragment** in relation to proximal one.

**Clinical Picture****Symptoms**

- History of trauma (+ type & onset of trauma +/- history of loss of consciousness)
- Pain.
- Swelling.
- Inability to use the affected limb (disturbance of function).

**Signs**⇒ **General:**

- Hemorrhage.
- Shock.
- Associated injury (brain, spinal cord, viscera).

⇒ **Local:**▪ **Exposure:**

- At least one joint above & one below.
- Exposure of the other side for comparison.

▪ **Inspection:**

- **Skin** → ecchymosis, bruises.
- **Soft tissue** → swelling
- **Bone** → deformity ± length discrepancy.

**Sure signs of fracture:**

1. Deformity.
2. Length discrepancy.
3. Crepitus.
4. Abnormal movement.

- **Palpation:**

- Tenderness.
- Crepitus & abnormal movement (better to be avoided to avoid neurogenic shock & neurovascular injury)
- Temperature (compare with the other side)
  - Warm = inflammation
  - Cold = vascular or nerve injury.

- **Movements:** both active & passive movements are lost or limited by pain +/- limping in L.L. fractures.

- **Neurovascular evaluation** → the check for neurovascular damage in a traumatized limb is more important than diagnosis of the fracture or the dislocation.

➤ **Absent pulses:** 1. Shock. 2. Vascular injury.

### Complications

- General.
- Local.

### Investigations

- **X-ray:**

- 2 views (A-P view, Lateral view) → for displacement
- 2 occasions → before & after reduction
- 2 joints → proximal & distal

### Treatment

1. **First Aid:** A B C D
2. **Resuscitation, monitoring & neurovascular evaluation.**
3. **Definitive treatment:**
  - Reduction (if displaced)
  - Fixation
  - Rehabilitation (passive & active)
  - Treatment of complications.

## Fracture healing

### Phases

- 1- Repair by granulation tissue. " few weeks "
- 2- Union of primary callus (an irregular mass of vascular bone and calcified cartilage at the site of fracture). " 2-3 months "
- 3- Formation of mature bone. " 4-6 months "

### Factors affecting healing process

1. **Age:** Fractures of children heal in a much shorter time than adults.
2. **Type of fracture:** Long oblique and spiral fractures heal more rapidly than transverse fractures.
3. **Position of segments:** If the fragments are impacted, union occurs rapidly. Distraction of the segments markedly delays healing.
4. **Vascularity of the fragments:** Impaired blood supply can lead to delayed healing. Fractures of the lower thirds of the tibia and ulna are also liable to delayed healing.
5. **Immobilization of the fragments.**
6. **Infection:** delays healing.



## Complications of Fractures

### A- General:

- 1- Shock.
- 2- Fat embolism.
- 3- Infections.
- 4- Crush \$.
- 5- Complications of prolonged recumbency.

### B- Local:

#### 1- Skin:

- a. Injury.
- b. Infection.
- c. Sores.

#### 2- Muscles & tendons:

- a. Injury.
- b. Myositis ossificans.

#### 3- Blood vessels:

- a. Acute ischemia.
- b. Compartmental \$.
- c. Volkmann's Ischemic contracture.

#### 4- Visceral injury.

#### 5- Nerve injury

#### 6- Bones:

- a. Non-union.
- b. Delayed union.
- c. Malunion.
- d. Ischemic necrosis.
- e. Growth arrest & stimulation.
- f. Shortening in LL fractures.
- g. Epiphyseal Injuries.

#### 7- Joints:

- a. Sudeck's atrophy.
- b. Traumatic Ossification.
- c. Ligamentous injuries & sprain.
- d. Hemarthrosis.
- e. Intra-articular fracture.
- f. Osteoarthrosis.
- g. Dislocation & subluxation.
- h. Septic arthritis.
- i. Effusion.
- j. Post traumatic joint stiffness.

#### ▪ Causes of gangrene after fracture in a limb:

- Direct crushing of tissues.
- Injury to the main vessels.
- Tight plasters.
- Clostridial infection.

# Details of Complications of Fractures

## A- General

### Shock

**A- Hypovolemic** → fluid replacement + blood transfusion.

**B- Neurogenic** → analgesic up to morphine.

**C- Septic** → antibiotics + debridement.

**D- Cardiogenic** (associated chest trauma) → +ve inotropics + careful pericardiocentesis & surgery.

### Fat Embolism

#### ▪ Clinical Picture:

- **Type of patient:** young patient
- **Trauma:** fracture long bone especially femur when immobilization & reduction are delayed
- **Time:** 2<sup>nd</sup> day.
- **Early:** - ↑ temperature. - ↑ Pulse.
- **Late:**
  1. Breathlessness + respiratory distress.
  2. Drowsiness, confusion, coma.
  3. Petechial hemorrhage.
  4. appearance of fat globules in sputum

#### ▪ Investigations:

1. ABG → ↓ PO<sub>2</sub>.
2. CXR.

#### ▪ Treatment:

- **Prophylaxis:**
  - High dose of O<sub>2</sub>.
  - Stabilization of fracture.
- **Curative:**
  - O<sub>2</sub>. - Corticosteroids.
  - Treatment of pulmonary embolism (heparin).

### Infections

- Tetanus, gas gangrene, acute & chronic osteomyelitis especially with open fractures.

### Crush Syndrome

#### ▪ Diagnostic criteria:

1. Crushing injury to a large mass of skeletal muscle.
2. Sensory and motor disturbances in the compressed limbs, which subsequently become tense and swollen (compartment syndrome)
3. Peak creatine kinase (CK) > 1000 U/L.
4. Myoglobinuria and/or hematuria.

} Rhabdomyolysis

#### ▪ Pathogenesis:

Continuous pressure or stretch on muscles → sarcolemma becomes leaky:

1. To inside the muscle → accumulation of the ECF inside the muscle → compartment syndrome & hypovolemic shock.
2. To outside → release of toxic substances into the circulation
  - K<sup>+</sup> → hyperkalemia.
  - Myoglobin → myoglobinuria & ARF.
  - Urates, phosphates ...etc

50% of patients develop acute RF due to hypo-volemic shock metabolic acidosis, nephrotoxic substances as myoglobin, urate, phosphate...etc.

▪ **Treatment:**

- **Emergency Treatment :**

- At site of accident or 1ry care room: ABCD.

- **At Hospital:**

- For crush injury → R&M + 1ry survey.
- For Rhabdomyolysis →
  - Forced mannitol-alkaline diuresis up to 8 L/d.
  - Alkalinization increases the urine solubility of acid hematin and aids in its excretion. This may protect against renal failure and should be continued until myoglobin is no longer detectable in the urine.
- For compartment syndrome →
  - fasciotomy & Immobilization of the limb,
  - Amputation if gangrene develops.

### Complications of Prolonged Recumbency

1. DVT & pulmonary embolism.
2. Bed sores.
3. Osteoporosis.
4. Renal stones.
5. Constipation.

### B- Early Local

#### Skin

**A- Injury.**

**B- Infection:** it leads to delayed healing, non-union and osteomyelitis.

**C- Sores:**

1. Pressure → mobilization – cleanness – air mattress.
2. Cast → avoid tight cast.

### Muscles & Tendons

➡ **Injury.**

#### Blood Vessels

**A. Hemorrhage**

**B. Acute Ischemia (Arterial Injury):**

▪ **Pathological Types:**

**a- without tear**

1. Spasm.
2. Contusion.
3. Compression from outside by cast or hematoma

**b- with tear**

1. Partial tear.
2. Complete tear.
  - It is essential to check the circulation in the distal part of the limb and if there is suspicion of vascular injury, an angiography can be performed.
  - If an arterial injury is diagnosed, ORIF are performed prior to the vascular repair. Venous injuries are also repaired.

▪ **Fracture fixation should be done before arterial repair.**

### C. Compartment Syndrome:

▪ **Definition:** Impairment of the circulation to a space due to ↑ pressure within it.

▪ **Pathophysiology:**

1. **Causes of ↑ pressure within a space (>30 mmHg):**

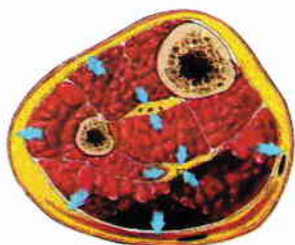
a) ↓ **Size of the compartment: tight cast.**

b) ↑ **contents of the compartment which is bound by an inelastic fasci**

- Bleeding within the space
- Traumatic muscle swelling.

2. **Sequelae**

↑ Pressure within the space → impaired venous drainage → ↑ capillary permeability → more swelling → vicious circle → ↓ perfusion → ischemia



#### General

- Crush syndrome

#### Local

- Gangrene
- Volkmann's ischemic contracture

3. **Common sites:** (compartments bound by an inelastic fascia)

- The 4 compartments of the leg: (anterior, lateral, superficial & deep posterior).
- The volar and dorsal compartments of the forearm.
- The intrinsic compartment of the hand.

The most common site is the leg or forearm (anterior Compartment)

▪ **Clinical Picture:**

- Severe pain on passive extension of digits. (finger or toes)
- Paralysis and absent pulse (late).

▪ **Complications:**

- Volkmann's ischemic contracture (see below).

▪ **Treatment:**

- Prevention → avoid tight casts or even delay cast if marked edema is suspected to occur.
- Curative → decompression
  - Fasciotomy & debridement of necrotic tissues.

### Avascular necrosis of bone

▪ **Vulnerable sites:**

1. **Femoral head:** after hip dislocation or fracture neck femur.
2. **Carpal scaphoid** (its proximal segment).
3. **Carpal lunate.**
4. **Talus:** after dislocation or fracture dislocation.

▪ **On X-Ray:**

- **Early cases** → appear normal.
- **After 3 months** → the avascular fragment becomes denser.

▪ **Treatment**

- In avascular necrosis of the head of femur → Austin-moore head (hemiarthroplasty).
- scaphoid ischemic necrosis → vascularized bone graft from the fibula.

**Visceral injury**

- A fracture of the Pelvis may be complicated by injury to the bladder or urethra

**Nerve Injury**

- **Pathological Types:**

- Neuropraxia, axonotmesis or neurotmesis.

- **Etiology:**

1. **Trauma by the fracture.**
2. **Nerve compression** e.g. compression of lateral popliteal n. against the outer bar of Thomas splint.
3. **Stretch of the nerve e.g.:** delayed ulnar neuritis in cubitus valgus.
4. **Entrapment of the nerve:** as in carpal tunnel syndrome due to entrapment of the median nerve.

- **Treatment:**

- a- **Closed** → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)  
→ If failed → explore & repair the nerve.

- b- **Open** → mark the nerve at 1<sup>st</sup> by black silk then delayed suturing (no 1<sup>ry</sup> repair).

**C- Delayed Local****1- Non-union:****Definition:**

- Complete failure of fracture to unite.

**Types:****A) HYPERTROPHIC:**

- Excessive callus formation which become calcified.
- **Causes:** presence of a gap (2 inches or more) due to:
  - a. Distraction by traction.
  - b. Soft tissue inter-position.
  - c. Bone loss.

**B) ATROPHIC:**

- Failure of union due to loss of blood supply.

**Clinical picture:**

- Persistent tenderness & abnormal range of mobility.

**X-ray:**

- Sclerosed ends.
- Medullary canal is closed by a dense bone.

**Treatment:**

- a. **Atrophic:** bone graft + rigid fixation.
- b. **Hypertrophic:** right fixation

**2- Delayed union:****Definition:**

- Fracture healing which takes longer than normal time.

**Causes:****a) Local:**

- Infection.
- Inadequate blood supply.
- Soft tissue interposition.
- Foreign body.
- Intra-articular fracture.
- Type of bone.



b) **General:**

- Age
- Nutrition.
- Systemic illness e.g. D.M.
- Drugs e.g. corticosteroids.

c) **Orthopedic intervention factors:**

- Improper reduction.
- Imperfect immobilization.
- Improper traction.
- Early mobilization.

**Clinical picture:**

- ▣ Persistent tenderness & abnormal range of mobility.

**X-ray:**

- Decalcified bone ends.
- Widened gap.

**Treatment:**

- ▣ Possible with proper prolonged uninterrupted immobilization.

|                            | DELAYED UNION                                                                                  | NON-UNION                                                                     |
|----------------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>Pathology</b>           | ▣ Bone ends are decalcified and the fracture line is widened into a gap full of fibrous tissue | ▣ The bone ends are sclerosed and the medullary canal is closed by dense bone |
| <b>Clinically</b>          | ▣ Abnormal movement and tenderness at the site of fracture                                     | ▣ Abnormal movement and tenderness at the site of fracture                    |
| <b>Spontaneous healing</b> | ▣ Possible with prolonged uninterrupted immobilization.                                        | ▣ Impossible                                                                  |

**3- Mal-union:****Definition:**

- ▣ Fracture which unites, but in a non-anatomical position.

**Types:**

1. Angular.
2. Rotational.
3. With shortening.

**Causes:**

1. Improper fixation.
2. Premature removal of the cast.

**Clinical picture:**

1. Deformity: cosmetic disfigurement.
2. Affection of limb function: limping.

**Complications:**

- ▣ Osteoarthritis of nearby joint.

**Treatment:**

- ▣ Corrective osteotomy.

**4- Sudeck's atrophy:****- Definition:**

- ▣ It is a syndrome of marked osteoporosis, associated with swelling of soft tissues, vascular stasis, pain & joint stiffness which may complicate

**- Etiology:**

- ▣ Unknown But may be due to:
  - Disuse atrophy.
  - Sympathetic overactivity → vasomotor imbalance in the form of arteriolar spasm.

- **Incidence:**
  - ▣ Colle's, Pott's fracture or scaphoid bone fracture (wrist or ankle injuries).
- **Prevention**
  - ▣ The joints which are not immobilized are exercised from the 1<sup>st</sup> day.
- **Treatment:**
  1. Physiotherapy, hot wax.
  2. Sympathetic block.
  3. **Sympathectomy.**
  4. **Analgesics.**

## 5- Myositis ossificans:

- **Definition.**
  - ▣ Deposition of Ca in soft tissues. i.e. heterotopic bone formation.
  - ▣ It is frequent after injuries of elbow or hip causing restriction of joint movement.
- **Mechanism:**
  - ▣ Muscle laceration → hematoma → becomes organized & calcified and may become transformed into bone when the **osteoblast invade the hematoma**
  - ▣ Massage & passive stretching of joints ↑ the tendency for traumatic ossification.
- **Prevention:**
  - ▣ Early reduction of fractures.
  - ▣ Avoid massage & passive exercise.
- **Treatment:**
  - ▣ During active stage → immobilization of this joint.
  - ▣ After 6 months → if still restrict the movement → resection (with tendency to recurrence especially if resected before 6 months).



## 6- Volkmann's Ischemic Contracture:

- **Definition:**
  - **Flexion** contractures caused by fibrosis of muscles of flexor compartment due to missed partial acute ischemia e.g. compartment syndrome
- **Pathology**
  - 1- Cause → acute ischemia of forearm muscles
    - infarction after 6-12 hours → muscle fibrosis
    - shortening within few months
  - 2- Flexors of the forearm are affected more than extensors and deep flexors are affected more than the superficial flexors.
  - 3- Flexor digitorum profundus is the most common muscle to be involved.
- **Clinical Picture:**
  - **Early** → Inability to fully extend the fingers
  - **Late** → Extension of the fingers is limited but improves as the wrist is flexed (fixed length phenomenon).
    - extension of metacarpophalangeal joints
    - fibrosis of flexors → complete claw hand
    - Hand grip is weak as the muscles still have some function (important diagnostic feature)
  - ▣ **D.D of complete claw hand** (some of the muscles will be completely paralyzed)



- **Treatment:**

- **Prophylactic:**

- Rapid reduction of the fracture.
- Assessment of vascular condition of limb.
- Avoid tight cast.

- **Curative:**

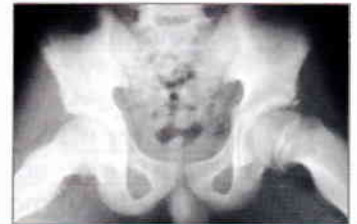
- **Early cases (within 8 hrs):**
  - Reduce the fracture if it is the cause.
  - Vasodilators.
  - If failed explore the artery & repair.
  - Fasciotomy if compartment syndrome.
  - Remove the cast if it is the cause.
- **Late cases (fibrosis):**
  - Mild → physiotherapy.
  - Severe → excision of dead ms & tendon transfer.

**7- Joint stiffness and osteoarthritis:**

- May occur after prolonged immobilization and after intra-articular fractures. certain joints as the elbow, shoulder and hip are prone to this problem.

**8- Growth disturbance:**

- May occur if the fracture affects the epiphyseal growth plate in children.



Slipped Lt. femoral epiphysis

**9- Osteoporosis:**

- Due to prolonged immobilization.

# Treatment of Fractures

## First Aid

### I- General → If poly-traumatized patient

#### A. Primary Survey

This includes a pre-hospital phase and a hospital phase

### ABCDE

#### A- Airway

- **Assessment:** if the patient is able to speak freely, his airway is patent.
- **Action:**
  1. Clear airway.
  2. Protect airway: oropharyngeal airway, tracheal intubation or cricothyroidotomy.
  3. Cervical spine control.

#### B- Breathing

- **Assessment:** inspection, palpation, percussion and auscultation (look - feel - listen).
- **Action:** e.g. Needle decompression for tension pneumothorax.

#### C- Circulation

- **Assessment:** general examination for hemorrhagic, cardiogenic or neurogenic shock.
- **Action:**
  1. Control bleeding.
  2. Restore the lost blood.

*Blood loss from specific fracture areas (1 unit = 500 ml)*

- Hip: **2-6 units.**
- Rib: 2-4 units.
- Femur: 2-4 units.
- Knees & legs: 2-4 units.
- Upper limb: **1-4 units.**

#### D- Disability

- **Assessment:** AVPU evaluation (alert, vocal, painful stimulation, unresponsive), followed by Glasgow coma scale in the secondary survey.

#### E- Exposure

- Insert Foley's catheter and nasogastric tube
- Radiological assessment
- AMPLE history (may be done in the secondary survey).

#### B. Secondary Survey

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

## II- Definitive Treatment at Hospital (local treatment)

### 1. Reduction

⇒ **Aims:**

- Allows end to end alignments.
- Allows shortest time for union.
- Allows full function of limb.

⇒ **Types:**

- **Closed:** (checked by x-ray)
  - Done under sedation/anesthesia.
  - **Methods:**
    - Gravity.
    - Closed manipulation.
    - Traction. This is particularly for fractures of long bones of the L.L. skin or skeletal traction is used to keep reduction of the fracture.

### ▪ **Open:**

#### ➤ **Indications:**

- Failed closed reduction (unstable).
- Open fractures.
- Other indications for internal fixation (injury of vessels, nerves & viscera).
- Intra-articular fracture: for accurate reduction → to avoid traumatic 2<sup>ry</sup> arthritis.
- Late unreduced fractures.

## 2. Fixation

**“Should include proximal and distal joints”**

### ⇒ **Non Rigid:**

- Risk of loss of reduction but stimulate rapid callus formation.
- **Types:**
  - **Plaster of Paris** (after it: check the pulse, do x-ray).
- **Advantages:**
  1. Cheap.
  2. Safe.
  3. Does not need extensive facilities.
- **Disadvantages:**
  1. Joint stiffness.
  2. Muscle atrophy.
  3. Inability to maintain perfect reduction during the period of immobilization.
  4. Liability to cause compartment syndrome or Volkmann's ischemic contracture.
- **Traction:** skin or skeletal.



External fixation

### ⇒ **Rigid:**

- Allows immediate loading but doesn't stimulate callus formation.

#### ▪ **Types:**

##### ○ **External skeletal fixators**

#### ➤ **Indications:**

- **Compound fracture**
- Fractures associated with severe soft tissue damage.
- **Nerve or vessel damage.**
- Severe comminuted & unstable fractures.
- Fractures of pelvis.
- **Infected fractures** (internal fixation is contraindicated).

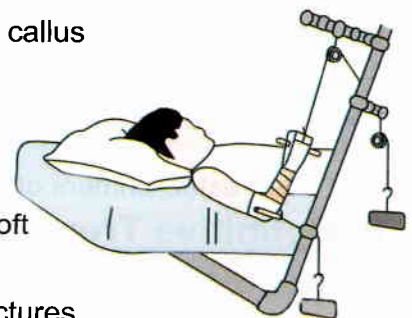
#### ➤ **Complications:**

- Pin-tract infection.
- Delayed union.

##### ○ **Internal fixation →**

#### ➤ **Indications :**

- Difficult fractures:
  - Those prone to non-union as femoral neck.
  - Those prone to mal-union as ankle fractures.
  - Those prone to be pulled apart by muscle action as transverse fractures of patella and olecranon.
- Unstable fractures.
- Poor union
- **Pathological fractures.**



Fixation by traction



- Multiple fracture
- Associated vascular injuries.
- Nursing difficulties:
  - Elderly patients.
  - Patients with traumatic paraplegia.

➤ **Types:**

- Screws.
- Wires.
- Plates & screws.
- Intramedullary nail (especially for comminuted fractures)
- Interlocking nails & screws.
- Dynamic compression screw & plate.

➤ **Choice: dependent on:**

- Patient.
- Type of fracture.
- Surgeon's competence.
- Facilities available.

➤ **Complications:**

- Infection.
- Non-union (due to inhibition of callus formation, damage to soft tissue & blood supply)
- Implant failure.
- Re-fracture.
- Mal-union.



Intertrochanteric fracture treated by internal fixation

## 3. Rehabilitation

### *Physiotherapy & active movement*

▪ **Aims:**

1-To prevent 5

- **To prevent** stiffening of joints.
- **To prevent** wasting of bones & muscles.
- **To prevent** osteoporosis.
- **To prevent** secondary syndromes.
- **To prevent** edema.

2- **Early:** to maintain the function of the uninjured parts.

3- **Later:** restoring function of the injured parts, once fracture healing occurs.

▪ **Methods:**

- Active exercise.
- Assisted movements.
- Functional activity.



Impacted femoral neck fracture treated by internal fixation with 3 parallel lag screws

## 4. Treatment of Complications

▪ **When ORIF is chosen the following should be considered:**

- Maintenance of maximum soft tissue coverage with interposition between the device and the skin surface.
- Maximum maintenance of periosteal and vascular tissues.
- Anatomic reduction and fixation stability.
- The use of high strength biocompatible implants.



Interlocking nail

# Open Fractures (Compound)

## Definition

- Fracture hematoma communicates with the exterior.

## Types

- **1ry:** i.e. trauma from **outside** cut skin then fracture the bone (open from the start, compound from without).
- **2ry:** i.e. trauma from **inside** (bone fragment causes skin injury, compound from within) 2ry to mobilization.

- ▶ **Types:** 1ry, 2ry
- ▶ **Comp.:** infection, bad union
- ▶ **TTT:** as trauma, wound debridement, external skeletal fixation

If injury from inside, it becomes less potentially infected.

## Complications

- **Infection.**
- Delayed union & non-union.

## Treatment

**It is an Emergency**

### First aid (See General)

- Airway** → patent.
- Breathing** → maintained.
- Circulation** → stop bleeding by wound dressing (no tourniquet).
- D** → **Don't** move limb → **Immobilization**.  
→ Drugs (e.g. morphia for pain).



## Definitive Treatment at Hospital

- Primary survey and second survey.**
- I.V. antibiotics should be administrated as soon as possible.**
- Geneal anesthesia.**
- Systemic wound debridement & irrigation:**
  - **Skin:** excise 1-2 mm from the edges.
  - **Fascia:** open tense fascia.
  - **Muscles:** excise dead muscles which is recognized by:
    - Color: bluish discoloration.
    - Consistency: mushy.
    - Contraction: not contract when pinched by forceps.
    - Circulation: not bleed when cut.
  - **Bone:** decontamination of bone by:
    - Curettage.
    - Pressure irrigation system (better).
  - **Nerve** → marks it for delayed repair.
  - **Blood vessels** → ligate, repair or graft (according to state of injured vessel).
  - **Skin:**
    - Clean (within 8 hrs) → closure without tension.
    - Infected (after 8 hrs) → leave it open + sterile dressing then delayed dressing or grafting.

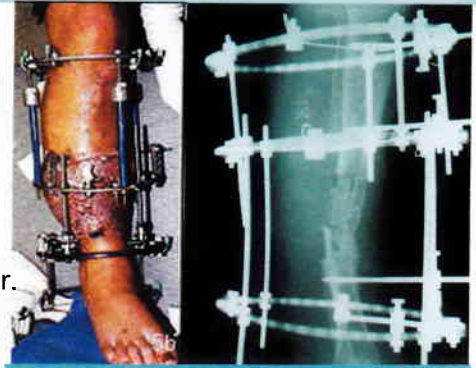
- Immediate wound closure is rarely indicated and should be performed once the wound contamination is low.

### e. Immobilization:

- External skeletal fixation.

## f. After care:

- Observe distal circulation.
- Antibiotics (broad spectrum)
- Antitetanic.
- Anti gas gangrene.
- Later:
  - o Skin: 2ry suture or graft (if loss).
  - o Non-union → bone graft.
  - o Nerves & tendons → delayed repair.



Open wound treated by external fixation and skin graft.

### Gustilo ital classification of open fractures

| Gustilo grade |                                                                                                                                                                                                                                                                                      |      |                            |      |                                             |      |                                 |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------|------|---------------------------------------------|------|---------------------------------|
| I             | Low energy, wound <1 cm in length                                                                                                                                                                                                                                                    |      |                            |      |                                             |      |                                 |
| II            | Wound > 1 cm in length.                                                                                                                                                                                                                                                              |      |                            |      |                                             |      |                                 |
| III           | a High energy wound with extensive tissue damage: <table border="1"> <tr> <td>IIIA</td><td>Adequate soft tissue loss.</td></tr> <tr> <td>IIIB</td><td>Extensive soft-tissue loss and bone damage.</td></tr> <tr> <td>IIIC</td><td>Associated with arterial injury</td></tr> </table> | IIIA | Adequate soft tissue loss. | IIIB | Extensive soft-tissue loss and bone damage. | IIIC | Associated with arterial injury |
| IIIA          | Adequate soft tissue loss.                                                                                                                                                                                                                                                           |      |                            |      |                                             |      |                                 |
| IIIB          | Extensive soft-tissue loss and bone damage.                                                                                                                                                                                                                                          |      |                            |      |                                             |      |                                 |
| IIIC          | Associated with arterial injury                                                                                                                                                                                                                                                      |      |                            |      |                                             |      |                                 |

# Upper Limb

## Fracture Clavicle

**Fracture between the middle and lateral 1/3  
(shaft, 80%)**

- **This is the commonest fracture in the whole body.** This is due to:
  - Change of curve.
  - Foramen for nutrient artery.
  - Groove for subclavius muscle.
  - Thinnest part of the bone.

### Trauma

- **Indirect:** fall on outstretched hand.
- **Direct:** blow to the clavicle or fall on the point of shoulder (less common).

### Displacement

- **Medial fragment:** pulled up by sternomastoid.
- **Lateral fragment:** is displaced downward by the weight of the limb.
- In children the fracture maybe of the greenstick variety.

### Clinical Picture

#### Symptoms

- History of trauma.
- Pain at site of fracture.
- Swelling at site of fracture.
- Inability to move the related upper limb.

#### Signs

##### 1. Inspection:

- Swelling, ecchymosis, bruises
- Deformity
  - Shoulder drop.
  - Step ladder deformity = over riding.
  - Characteristic posture ([position of lactating mother](#)).
    - The patient usually supports the elbow with the other hand & bends his head towards fracture site (to relax sternomastoid).

##### 2. Palpation:

- Broken displaced clavicle.
- Tenderness at site of fracture.
- Crepitus & abnormal movements (better to be avoided) to avoid injury of patient structures.

##### 3. Movements: both active & passive movements are lost or limited by pain.

##### 4. Neurovascular evaluation:

- Major vessels e.g. subclavian vessels → 6P<sub>s</sub>
- Brachial plexus (C<sub>8</sub> & T<sub>1</sub>).
- Deformity → claw hand
- Sensory loss →
  - ⇒ Medial side of forearm.
  - ⇒ Medial 3 ½ fingers.

##### 5. Associated injuries: e.g. head, neck, acromioclavicular, ribs.

The commonest fracture in the body

- ▶ **Etiology:** indirect, direct trauma
- ▶ **C/P:** as scheme + step ladder deformity + position of lactating mother
- ▶ **Comp.:** as scheme + injury of (brachial plexus, subclavian B.V.)
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma + broad arm sling (3wks)





## Complications

- **Malunion**  
(most common but not of functional significance).
  - Costoclavicular syndrome
- **Non-union** (especially in fracture of the lateral end) uncommon due to rich blood supply).
- Shoulder stiffness. (Especially in elderly).
- **Stiffness of the shoulder in the elderly.**
- **Injury of:**
  - Brachial plexus especially the lower trunk.
    - Motor → wasting of small muscles of the hand.
  - Subclavian vessels (rare).
  - Pleura and lung.



## Investigations

- **X-ray:**
  - Antero-posterior :-  
Fracture between medial 2/3 & lat 1/3 with overlap of fragments.

## Treatment

- If a part of polytraumatized patient → **ABCD** then **R & M**.
- A broad arm sling for 3 weeks and analgesics.
- Internal fixation is rarely needed when there is associated vascular or nerve injury.

### ⇒ Other rare types:-

1. Fracture of outer 1/3 (15%):
  - Usually no displacement occurs.
  - But displacement may occur (if coraco-clavicular ligament is ruptured). The outer segment is displaced forwards and inwards.
  - Non union is common.
  - **Treatment:**
    - If not displaced → no treatment.
    - If displaced → internal fixation.
2. Fracture of inner 1/3 (5%).



# Shoulder Dislocation

## Incidence

- It is the most commonly major dislocated joint of the body (45%).
- It is a **common** injury in **adolescents & young adults**.
- It is common because:
  - Shallow glenoid cavity & large head of humerus.
  - Wide range of shoulder movements.
  - Lax capsule & weak ligament.



## Types

- It may be anterior or posterior.

## I. Anterior Dislocation

(The commonest 97-98%)

## Trauma

- Forced extension and external rotation of the abducted arm.

## Displacement

- The head of the humerus lies in front of the glenoid cavity**, it may be:
  - Subcoracoid (**the commonest**).
  - Subclavicular.
  - Luxatio erecta is an anterior dislocation in which the arm is abducted above the head.
- Joint capsule:** torn.
- Glenoid labrum:** avulsed
- Once the head is in its new subcoracoid position, the humerus is locked in this position by muscle spasm.
  - ➔ This predispose to recurrent dislocation

- **Etiology:** Forced extension and ext. rotation of the abducted arm
- **C/P:** as scheme + patient holds the injured limb by the other hand in position of slight abduction + flat shoulder
- **Comp.:** inj. of axillary n. & art., recurrence\*
- **Invest.:** X-ray
- **TTT:** reduction by Kocher's method



## Clinical Picture

### Symptoms

- History of trauma. (see above)
- Pain.
- Swelling.
- Inability to move the affected limb (all shoulder movements are limited and painful).

### Signs

#### 1. Inspection:

- Swelling.
- The arm appears to take origin from a point just under junction of middle and outer thirds of the clavicle.
- Deformity:
  - o The patient holds the injured limb at the elbow by the other hand in position of slight abduction.
  - o Loss of shoulder contour (flattening).
  - o Loss of axillary concavity.



**2. Palpation:**

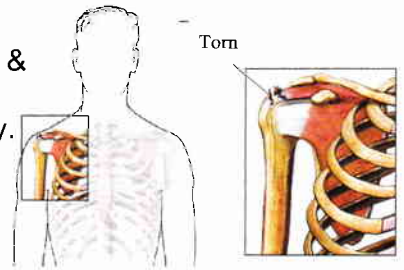
- Head is palpable anteriorly (In the subcoracoid or subclavicular region)
- Empty space under the acromion (empty glenoid cavity).

**3. Movement:** complete limitation of shoulder movements.**4. Neurovascular evaluation:**

- Axillary nerve → Deltoid muscle wasting & sensory loss over its lateral aspect of arm.
- Axillary artery → 6P<sub>s</sub>.

**5. Associated injuries.** (See Complications)**Complications****A- Early**

- **Axillary nerve injury:** (mostly neuropraxia) 50%
- **Axillary artery injury** → 6P<sub>s</sub>.
- **Associated Fractures** e.g. **greater tuberosity** (usually results from excessive forces during shoulder reduction).
- **Rotator cuff tear:**
  - Includes: supraspinatus, infraspinatus, subscapularis & teres minor muscles).
  - It complicates anterior dislocation especially in elderly.
  - C/P:
    - Avulsion of supraspinatus → inability to initiate abduction.
  - Diagnosed by U/S or arthrogram.

**B- Late: Recurrent Dislocation (The commonest)**

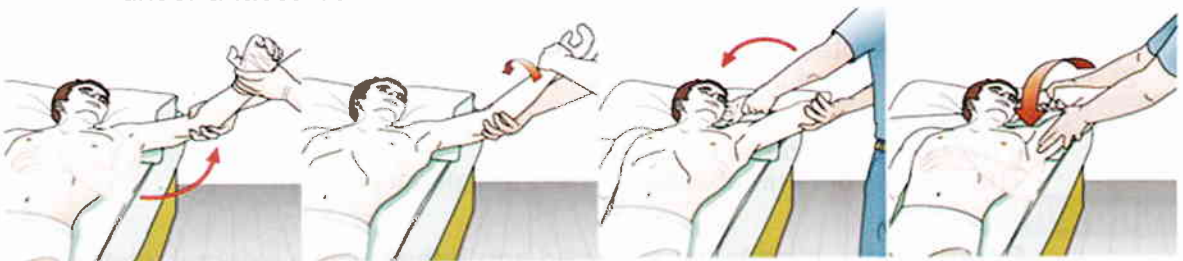
- It is due to detachment of the labrum glenoidal and the anterior capsule from the anterior margin of glenoid.
- Clinically redislocation occurs easily following minor daily actions as combing of hair.
- Reduction is easy and usually the patient can reduce the dislocation by himself.

**Investigations****▪ X-ray:****1. Antero-posterior view:**

- Confirm the diagnosis → humeral head outside the glenoid cavity.
- Associated fractures.

**2. Lateral view:** confirms that it is **Anterior** dislocation.**Treatment****Reduction under sedation or sometimes GA** To relax the muscles**▪ Kocher's method:**

- Outward traction.
- External rotation for few minutes to relax counter acting muscles
- Internal rotation and adduction.
- Reduction is confirmed by putting the shoulder through full range of movement under anaesthesia.



- **Hippocratic method:** (not done now):
  - Foot in axilla & do gentle traction.
  - Used in neglected cases.
  - When only one operator is available.



Reduction is confirmed by full range of movement under sedation or anaesthesia.

## Immobilization

- In adduction & internal rotation for 3wks a broad arm sling or adhesive strap.
- Prolonged immobilization, as previously recommended, doesn't seem to ↓ recurrence rate.

## Rehabilitation

- Advice the patient to avoid vigorous movement.

## Treatment of Complications

1. **Axillary artery:**
  - ⇒ Reduction:
    - If pulse returns → follow up.
    - If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.
2. **Axillary nerve:**
  - ⇒ Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
    - If failed → explore & repair the nerve.
  - ⇒ Open → mark the nerve at 1st by black silk
    - Then delayed suturing (no 1ry repair).
3. **Fracture greater tuberosity:**
  - ⇒ **First:** reduction by putting the arm in abduction.
  - ⇒ **If failed:** ORIF.
4. **Rotator cuff tear:**
  - ⇒ Needs repair in young patient.
5. **Recurrent anterior dislocation:**
  - ⇒ **Operation is indicated when the disability is great.**
    - Putti-Platt operation: The idea is to limit external rotation of the shoulder by capsulorrhaphy and shortening of the subscapularis muscle by overlapping.
    - Bankart operation: Has better results. The original lesion of the capsule or labrum is repaired by reattaching the labrum by suturing it to the bony rim of the glenoid.

## 2. Posterior Dislocation

(Less common)

### Trauma

- 1) Forcible internal rotation of abducted arm.
- 2) Direct blow on front of the shoulder.
- 3) Epileptic fit.

### Displacement

- It may be subacromial or subspinous
- The head of the humerus lies behind the glenoid cavity.

### Treatment

- **Reduction:** traction to the abducted arm & then gentle external rotation.



# Fracture of scapula

➔ **The commonest fractures of the scapula involve the neck or the body of the bone.**

1. Fracture of the neck of the scapula. Here the fracture results from direct violence. The fracture line runs from the supra-scapular notch to below the coracoid process. Treatment is by application of a broad arm sling and early active shoulder movement as pain subsides.
2. Fracture of the body of the scapula. This fracture also results from direct violence. The fracture line may be stellate. Comminution is common. Treatment is the same as above. It is important to look for and exclude an associated chest injury.

## Fracture surgical neck of the humerus

- Usually in elderly patients associated with osteoporosis
- May be impacted or unimpacted
- Most important complication is axillary nerve injury → paralysis of deltoid & loss of sensation in skin overlying it "badge area"

# Fracture Shaft Humerus

## Incidence

- Very common fracture in all ages.

## Trauma

- **Indirect** → fall on outstretched hand.
- **Direct** → blow to the arm.

## Displacement

▶ **Etiology:** indirect, direct trauma

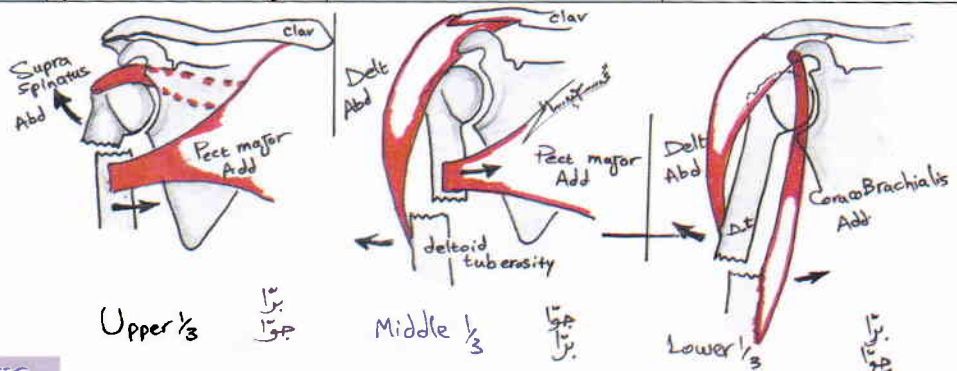
▶ **C/P:** as scheme

▶ **Comp.:** radial n. injury

▶ **Invest.:** X-ray

▶ **TTT:** as trauma + U shaped plaster or ORIF

|                | Upper 1/3<br>(just below<br>surgical neck) | Middle 1/3<br>(above deltoid<br>tuberosity) | Lower 1/3<br>(below deltoid<br>tuberosity) |
|----------------|--------------------------------------------|---------------------------------------------|--------------------------------------------|
| Upper fragment | Abducted by<br>supraspinatus               | Adducted by<br>pectoralis major             | Abducted by<br>deltoid                     |
| Lower fragment | Adducted by<br>pectoralis major            | Abducted by<br>deltoid                      | Adducted by<br>coracobrachialis.           |



## Clinical Picture

### Symptoms

- History of trauma.
- Pain in the arm.
- Swelling in the arm.
- Inability to move the limb

## Signs

- **General: (if poly-traumatized patient)**
  - Shock.
  - Associated injuries.
- **Local:**
  1. **Inspection** →
    - Ecchymosis, bruises, swelling.
    - The patient supports the arm by the other hand.
  2. **Palpation** → Tenderness, crepitus.
  3. **Movement** → limitation of active & passive movement due to pain.
  4. **Neurovascular evaluation** → **radial nerve** (mostly neuropraxia):
    - a. **Motor**: wrist drop & finger drop.
    - b. **Sensory**: loss of sensation on the dorsum of the hand at the base of thumb (clinically it's localized to snuff box).

## Complications

- Radial nerve injury.
- Non-union, mal-union and delayed union, joint stiffness.

## Investigation

- **X-ray.**

## Treatment

(If a part of poly-traumatized patient → **ABCD** then **R&M**)

1. **Undisplaced simple fracture** → U-shaped plaster.
2. **Open reduction & internal fixation:**
  - **By** → Plate & screw.  
→ Interlocking intramedullary nail.
  - **If** → Unstable.  
→ Radial nerve palsy.  
→ Clean open wound.
3. **Treatment of complications:**
  - **Radial nerve injury**
    - ⇒ Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis).
      - If failed → explore & repair the nerve.
    - ⇒ Open → mark the nerve at 1st by black silk.
      - Then delayed suturing (no 1ry repair).



# Supracondylar Fracture of Humerus

## Site

- Distal Metaphysis area just above the 2 condyles of humerus.

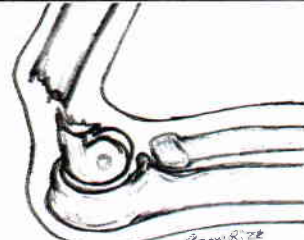
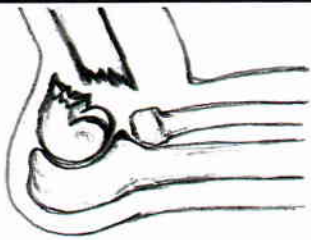
## Incidence

- Commonest** elbow injury in children.
- 50% complete, 50% Greenstick

## Trauma & Displacement

- **Etiology:** extension type, flexion type
- **C/P:** painful passive extension of fingers, equidistant  $\Delta$  on flexed elbow, supracondylar ridge  $\rightarrow$  interrupted
- **Comp.:** as scheme + acute ischemia\*
- **Invest.:** X-ray
- **TTT:** - post. plaster slap & collar  
- Reduction (open or closed) & fixation

| Extension type                                                                                                                                                                                                                             | Flexion type                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>99% (the commonest✓).</b>                                                                                                                                                                                                               | <b>1%</b>                                                       |
| Fall on outstretched hands.                                                                                                                                                                                                                | Fall on tip of flexed elbow.                                    |
| <ul style="list-style-type: none"> <li>Distal fragment is displaced posteriorly by triceps.</li> <li>Pronation of the distal fragment because the hand is usually pronated at time of trauma. medial or lateral shift may occur</li> </ul> | Distal fragment is displaced anteriorly by biceps & brachialis. |



**N.B:** The fracture is Greenstick in 50% and complete in 50% of cases.

## Clinical Picture

### Symptoms

- History of trauma. (see before)
- Pain (severe) around elbow.
- Swelling around elbow.
- Partial or complete limitation of movement around elbow joint.
- +/- Neurovascular injuries: painful passive extension of fingers (Early Volkmann's ischemia)

### Signs

- Inspection:**
  - Swelling.
  - Deformity of elbow  $\rightarrow$  extension or flexion.
  - Ecchymosis and bruises.
- Palpation**
  - Tenderness around elbow.
  - Crepitus (to be avoided).
  - Specific signs:
    - Relation between medial & lateral epicondyles & tip of elbow are not disturbed forming an equidistant  $\Delta$  on flexed elbow (DD of elbow dislocation).
    - Supracondylar ridge  $\rightarrow$  interrupted.
- Movement**
  - Both active & passive  $\rightarrow$  limited by pain.
  - $\pm$  crepitus.
- Neurovascular evaluation:**

- a) **Brachial a.** may be affected causing acute ischemia (**6Ps**).  
 - Pain, paralysis, parathesia, pallor, pulseless & progressive coldness.

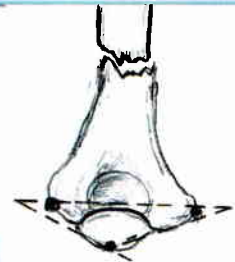
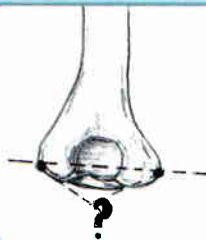
b) **Manifestations of nerve injury:**

|           | Deformity            | Sensory loss                                                                                     | Tests for motor                      |
|-----------|----------------------|--------------------------------------------------------------------------------------------------|--------------------------------------|
| Median n. | Ape hand.            | - Lat 2/3 of palm.<br>- Palmar aspect of lat 3 ½ finger with dorsal of their terminal phalanges. | - Counting finger.<br>- Pencil test. |
| Ulnar n.  | Partial claw hand.   | - Med 1/3 of palm + palmar & dorsal aspect of med 1 ½ fingers.                                   | - Card test.<br>- Froment's test.    |
| Radial n. | Wrist & finger drop. | - Lat 2/3 of dorsum<br>(Actually snuff box only is affected).                                    | - Ask patient to extend thumb!!      |

DD

|                                                                                                                         | Extension Type                         | Post. Dislocation of Elbow                  |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------|
| Age.                                                                                                                    | Pediatric fracture.                    | Usually in adults.                          |
| Mobility.                                                                                                               | Painful limitation of active movement. | Absolute loss of active & passive movement. |
| 3 bony points at elbow.                                                                                                 | Normal relationship.                   | Disturbed relationship.                     |
| Supracondylar ridge.                                                                                                    | Interrupted.                           | Normal.                                     |
| Measurement:<br>a- From the tip of acromion to lateral epicondyle.<br>b- From the lat. epicondyle to styloid of radius: | Interrupted.<br><br>Normal.            | Normal.<br><br>Interrupted.                 |
| X-ray:                                                                                                                  | Fracture Line.                         | Dislocation.                                |

- Normally, the 3 bony landmarks (medial & lateral epicondyles & the olecranon) forms equidistant triangle with the elbow flexed & on straight line with elbow extended



## Complications

### A. The most important complications include

- Acute ischemia** → 6Ps.
  - If not treated (within 6-8 hours) will lead to:
    - Chronic ischemia.
    - Volkmann's ischemic contracture manifested by:
      - a) Clawing of fingers & on trial to extend it passively → ↑ flexion of wrist (**Volkmann's sign**).
      - b) Wasting of forearm muscles.
      - c) Trophic changes of overlying skin.
- Myositis ossificans**: muscle hematoma with overlying ossification.
- Malunion**: In the form of cubitus **varus** and **valgus**.

- Cubitus varus is more common.
- Cubitus valgus leads to delayed ulnar neuritis.

4. Nerve injuries: Anterior interosseus nerve (branch of median) > ulnar nerve > radial nerve.

### B. Other complications

1. Skin → tear, blisters & necrosis.
2. Muscles & tendons → tear in brachialis m. or tendons.
3. Elbow stiffness & arthritis (on long standing cases).

### Investigations

- **X-ray:**
  - AP & lateral Views.
  - Fracture line & the displacement.

### Treatment

→ If a part of poly-traumatized patient → ABCD then R&M.

### Reduction & Fixation

#### a. Undisplaced fractures and Greenstick fractures with angulation less than 20°

require no manipulations.

- Fixation is achieved by using a posterior plaster slap and a collar and cuff with the elbow flexed for 3 weeks.

#### b. Greenstick fractures with angulation more than 20°

require reduction by flexion only then fixation as above.

#### c. Displaced:

⇒ Closed reduction & Fixation by a posterior slap for 3 – 4 weeks.

##### ➤ **Indications:**

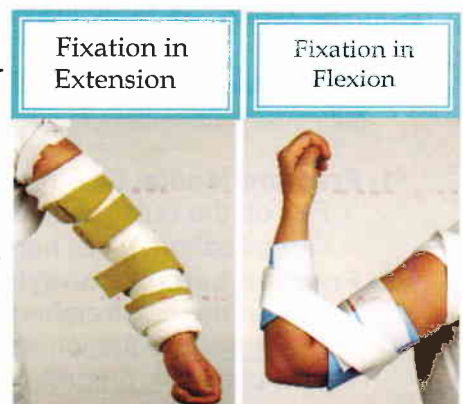
- In all children fracture and small percent of adult fractures

##### ➤ **Steps:**

- Under GA
- Distal fragment is pulled downward & pushed forward in extension type or backward in flexion type, then lateral or medial displacement is corrected.
- Carrying angle is checked
- Fixation by **above elbow back splint**.
  - If flexion type → extension of elbow.
  - If extension type → flexion of elbow 80° "stretched triceps muscle prevents redisplacement"
- **Radial pulse observation throughout the maneuver if it become weak or not palpable elbow should be extended immediately.**



Displaced supracondylar fracture humerus



However some surgeons prefer to fix these fractures in extension whatever the type for better correction of carrying angle and to decrease arterial impairment.

⇒ **Open reduction**➤ **Indications:**

- In adult fracture
- Open fracture.
- Vascular injury not improved after closed reduction.
- Failed closed (unstable).

⇒ **External skeletal fixation (if open) (Dunlop traction).****Rehabilitation**

- Active elbow movement.
- Physiotherapy.
- Hospitalization for 48 h. for observation of circulation, If impaired at any time → slap is removed & elbow is extended.
- Never apply a complete plaster above elbow for injuries around elbow joint due to the ↑ risk of edema which if occurred while a complete plaster is applied → may lead to compartment syndrome.

**Treatment of complications****1. Brachial a. injury:**a- Acute ischemia (should be managed within 6-8 hour):

⇒ Reduction of the fracture:

- If pulse returns → follow up
- If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.

b- Volkmann's → tendon transfer.**2. Myositis ossificans:** (avoid massage)

- Prolonged immobilization.
- If residual lesion → excision after 9 months.

**3. Mal-union** → corrective osteotomy + plating.**4. Nerve injury:**

- a- Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
  - If failed → explore & repair the nerve.
- b- Open → Mark the nerve at 1st by black silk.
  - Then delayed suturing (no 1<sup>st</sup> repair).

**5. Open fracture** → **AB + external skeletal fixation.****1- Fracture Medial Condyle**☑

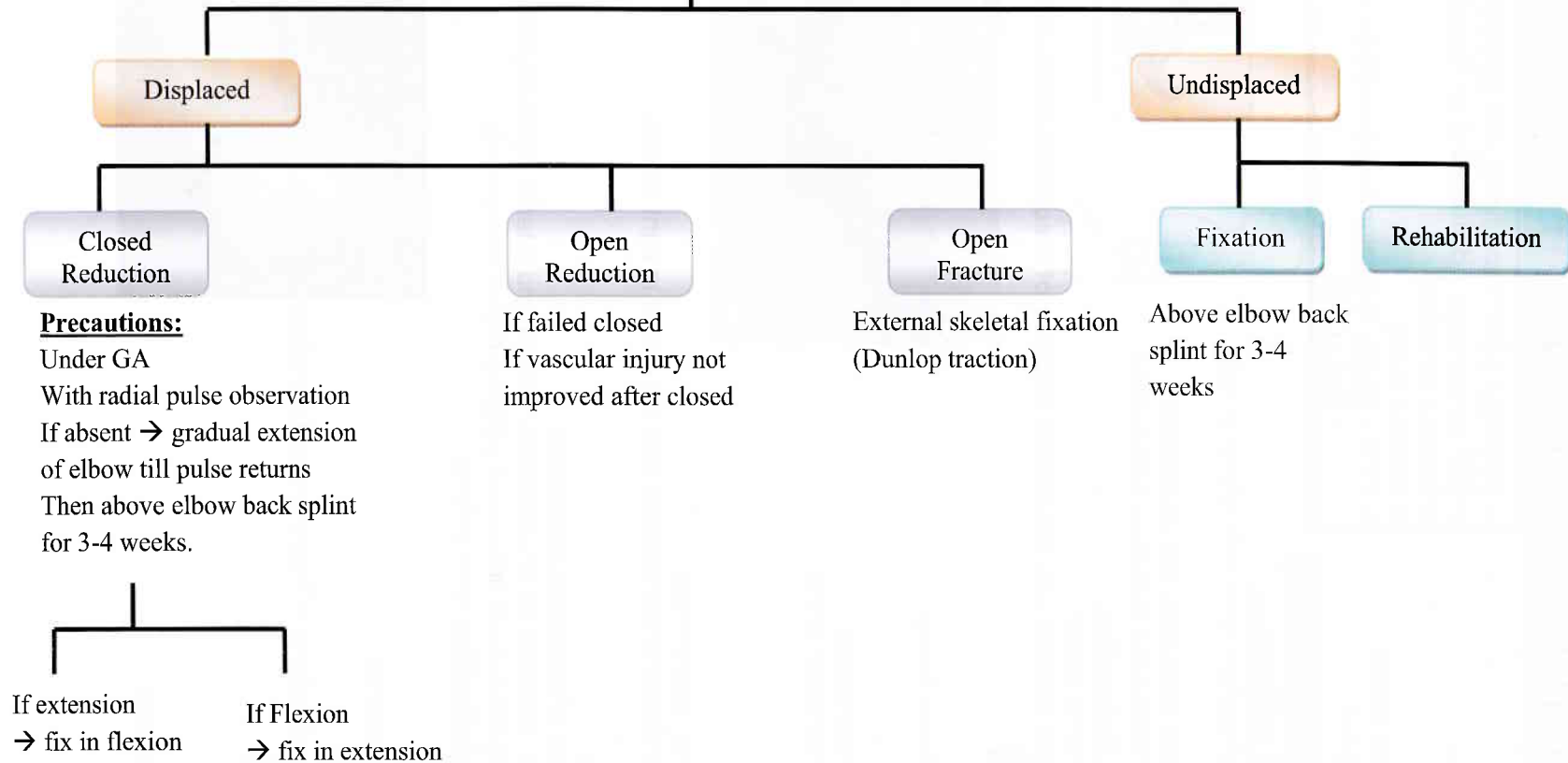
- Fall on the outstretched hand
- Complication: ulnar nerve paralysis

**2- Fracture Lateral Condyle**

- Fall on the outstretched hand
- **Treatment** reduction and internal fixation.
- Complication: progressive cubitus valgus and delayed ulnar neuritis



## Treatment of supracondylar fracture humerus





# Elbow Dislocation

## Incidence

- **Adults** > children.

## Types

- It may be posterior (more common) or anterior.

- ▶ **Etiology:** post.\* (coronoid), ant. (olecranon)
- ▶ **C/P:** as scheme + disturbed  $\Delta$  on flexed elbow
- ▶ **Comp.:** as before
- ▶ **Invest.:** X-ray
- ▶ **TTT:** - **Post.:** reduction + above elbow cast
- **Ant.:** ORIF

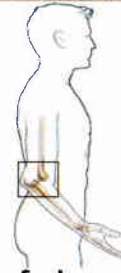
## Trauma and Displacement

### 1. Posterior elbow dislocation:

- Fall on outstretched hand with elbow in mild flexion
- Ulna migrates backward with associated **fracture of coronoid** (Fracture dislocation).

### 2. Anterior elbow dislocation:

- Direct trauma to elbow.
- Ulna migrates forward with associated **fracture of olecranon** (fracture dislocation).



Dislocated elbow

## Clinical Picture

### Symptoms

- History of trauma (see before)
- Pain.
- Swelling.
- Inability to move the elbow.
- Neurovascular injury (see before)

### Signs

#### 1. Inspection:

- Swelling.
- Local bruises, ecchymosis.
- The patient supports the forearm with the elbow in light flexion.

#### 2. Palpation:

- Tenderness.
- Prominent tip of olecranon posteriorly.
- Disturbed  $\Delta$ . between tip of olecranon, medial and lateral epicondyles

#### 3. Movement: complete loss of active and passive elbow movements.

#### 4. Neurovascular evaluation (see before)



## DD

- Supracondylar fractures.

## Complications

- See before ( complications of injury around the elbow)

## Investigations

### ▪ **X-ray:**

- Dislocation.
- Associated fracture.



## Treatment

### Posterior Dislocation

#### 1. Reduction:

- Under GA + muscle relaxant → downward then forward traction.
- X-ray → confirms the reduction.
- Check movements after treatment.

#### 2. Fixation:

- Above elbow cast → 3wks.
- Active exercise → 3wks.



### Anterior Dislocation

- ORIF using long screw.

### Treatment of Complications

- **Brachial artery:** reduction of the dislocation:
  - If pulse returns → follow-up.
  - If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.

## Complications of Injuries around the Elbow

### General

- Neurogenic shock.

### Local

#### A- Early complications

##### 1. Vascular injury → **brachial artery** (acute ischemia):

###### ▪ Caused by:

- Supracondylar fracture humerus (sharp lower end of upper fragment).
- Elbow dislocation.

###### ▪ Clinical picture:

1. History of trauma.
2. 6Ps: (**P**ain, **P**allor, **P**rogressive coldness, **P**ulseless, **P**aralysis & **P**araesthesia).
3. Complications: (wet gangrene – compartment syndrome – Volkmann's Ischemic contracture).

###### ▪ Treatment:

⇒ Reduction of the fracture:

- If pulse returns → follow up.
- If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.

##### 2. **Compartment syndrome:** occurs when blood supply is dramatically reduced to muscles in a closed body space surrounded by a tough fascia.

##### 3. **Nerve injury:**

###### ▪ Caused by:

- Supracondylar fracture humerus.
- Elbow dislocation.

- Affected nerve: median (commonest), ulnar, radial.

#### ► **Early:**

- acute ischemia,
- compartment \$,
- nerve injury (median\*)

#### ► **Late:**

- malunion, non-union
- Volkmann's contracture
- Delayed ulnar palsy
- Myositis ossificans
- Joint complications

- Leads to: sensory & motor manifestations according to the injured nerve.
  - Closed → expectant Treatment for 6 months + massage + electric stimulation (neuropraxia or axonotmesis)
    - If failed → explore & repair the nerve.
  - Open → mark the nerve at 1st by black silk
    - Then delayed suturing (no 1ry repair).

## B- Late complications

### 1. Fracture itself:

- Malunion: deformity (cubitus varus or cubitus valgus).
- Non union: in
  - Olecranon fracture.
  - Radial head fracture.
  - Condylar fracture.
  - Epicondylar fracture.

### 2. Vascular:

#### ▪ Volkmann's ischemic contracture:

##### - Clinical picture:

- Early → inability to fully extend the fingers, pain in the forearm with passive extension.
- Late → fibrosis of flexors → complete claw hand.

##### - Treatment:

##### ○ Prophylactic:

1. Rapid reduction of the fracture.
2. Assessment of vascular condition of limb.
3. Early treatment of acute ischemia.
4. Avoid tight cast.

##### ○ Curative:

- ⇒ Early cases (within 8 hrs):
  - Remove the cast if it is the cause.
  - Reduce the fracture if it is the cause.
  - Vasodilators.
  - If failed explore the artery & repair.
- ⇒ Late cases (fibrosis):
  - Mild → physiotherapy.
  - Severe → excision of dead muscles & tendon transfer.
  - muscle slide operation : common flexor origin is detached from medial epicondyle & fixed in lower level

### 3. Nervous:

- Delayed ulnar nerve palsy: If mal-union → cubitus valgus.

### 4. Muscles:

- Myositis ossificans: (post traumatic ossification):
  - Calcified hematoma in muscle (brachialis 90%, triceps 10%).
  - X-ray: hyperdense shadow.
  - Treatment: excision after 6 months.

### 5. Joints:

- Elbow stiffness due to:
  - Prolonged immobilization.
  - Intra-articular extension of fracture.
  - Surgery complicated by infection.
  - Myositis ossificans.
- Neglected dislocation.
- Recurrent dislocation & chronic inability.
- Osteoarthritis: due to improper reduction of the articular surface.

### 6. Skin: cast sores.

## Fracture Olecranon

### Incidence

- Rare
- usually associated with anterior elbow dislocation

### Trauma

- Fall on outstretched hand
- Direct blow
- Sudden contracture of triceps

### Clinical Picture & complications

- ➡ As elbow dislocation ± gap

### Treatment

- ORIF by wire or long screw

## Fracture Head of Radius

- Common in adolescent and old age.
- Very rare in children.

### Trauma

- Fall on outstretched hand.

### Clinical Picture

- Pain in elbow.
- Painful pronation & supination of forearm (diagnostic).

### Treatment

- Single large fragment → ORIF
- Comminuted fracture → excision of head of radius

In case of fracture of neck of radius or separation of upper radial epiphysis in children, excision of head of radius shouldn't be done otherwise the ulna will overgrow than the radius causing progressive madelung deformity



# Colles' Fracture

## Definition

- It is an **extra-articular** fracture which occurs about **1 inch above the distal end of radius** with **posterolateral shift & tilt** of the lower segment occurs in **elderly women**.

## Site

- Extra-articular.
- Lower radius (1 inch above the distal end of radius) in the cancellous part

- **C/P:** ♀ > 50 years with: as scheme + partial affection of movement around wrist joint + dinner fork deformity + radial styloid process is no longer lower than that of ulna + Allen's test (radial art. affection)
- **Comp.:** sudeck's atrophy, Madelung deformity, carpal tunnel \$, inj. of (radial art., median n.)
- **Invest.:** X-ray
- **TTT:** Closed red. & fix. (below elbow cast)

Smith fracture



Colles' fracture



## Incidence

- Most common in **female > 50 years** (postmenopausal osteoporosis).

## Trauma

- Fall on the palm of outstretched hand.

## Displacement

- Posterolateral shift & tilt ± upward impaction & supination.
- There is always an associated injury to the inferior radio-ulnar joint and the ulnar styloid process may be avulsed.

## Clinical Picture

## Symptoms

- History of trauma.
- Pain above wrist.
- Swelling above wrist.
- Partial** affection of movement around wrist joint.

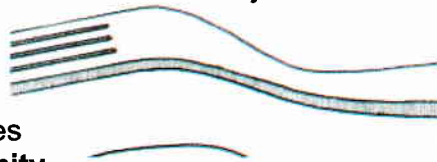
## Signs

### 1. Inspection:

- Swelling
- Ecchymosis, bruises
- Dinner fork deformity.**

### 2. Palpation:

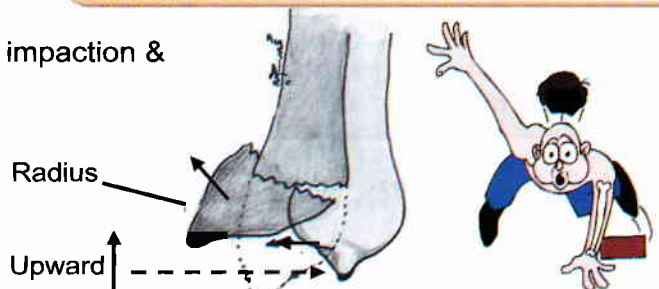
- Tenderness around wrist.
- No Crepitus.
- Radial styloid process is **no longer** lower than that of ulna.



Lateral view



- Common fractures in post-menopausal females:
  - Fracture surgical neck of humerus.
  - Fracture neck of femur.
  - Colles' fracture.





3. **Movement:**

- Loss of active movement + painful passive movement

4. **Neurovascular evaluation:**

- Radial a. may be affected so **Allen's test** is needed.
- Median n. injury:
  - o Deformity → Ape hand.
  - o Sensory loss - Lat 2/3 of palm.
    - Palmar aspect of lat 3 ½ finger with dorsal of their terminal phalanges.
  - o Tests for motor power - Counting finger. - Pencil test.



1 Radial growth plate  
2 Fracture site at the lower end of the radius.

**Complications**

*The most important complications include:*

- 1- **Malunion:** While union is the rule, there is often some residual deformity because:
  - Redisplacement may occur inside the cast especially if the posterior cortex is comminuted.
  - A Colles' plaster does not control the supination element of the deformity.
- 2- **Sudeck's atrophy:** (unknown etiology)
  - This is a form of reflex sympathetic dystrophy with increased blood flow to peri-articular areas
  - Severe pain causing sympathetic stimulation & VC → local osteoporosis → more pain (vicious circle).
- 3- Epiphyseal dislocation in children → **Madelung** deformity.
- 4- **Radial artery injury.**
- 5- **Median nerve injury.**
- 6- **Carpal tunnel syndrome:**
  - Late complication with mal-union due to compression of median n.
  - As usual C/P of median n. injury (**BUT** sparing sensation of palm).
- 7- **Other complications:-**
  - Skin → tear, blisters & necrosis.
  - Muscles & tendons → **rupture of extensor pollicis longus tendon.**
  - **Wrist stiffness & arthritis** (on longstanding cases).



Madelung deformity

**DD**

1. **Smith** fracture (reverse of Colles').
2. **Chauffeur** fracture (fracture styloid process of radius).
3. Scaphoid fracture.

**Investigations**▪ **X-ray:**

- **AP view:**
  - Fracture line (in metaphysis of radius).
  - Lateral shift or tilt.
  - Radial shortening (= upward impaction).
- **Lateral view:**
  - Dorsal displacement or tilt of the distal fragment
  - Subluxation of inferior radioulnar joint.



Colle's fracture

▪ **Possible deformities that can occur with Colles' fracture:**

- **Dinner fork.** - **Madelung.**
- **Ape hand.**

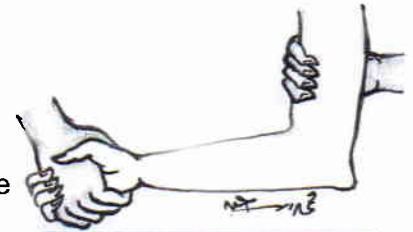
### Treatment

- If a part of poly-traumatized patient → **ABCD** then **R&M**.

### Reduction & Fixation for 4 – 6 weeks

#### 1. Closed reduction & fixation by cast under GA:

- Traction of the hand "as if shaking hands".
- Counter traction of humerus.
- Push the distal fragment anteriorly & medially.
- If isolated Colles' → below elbow cast holding the wrist in palmar flexion and ulnar deviation.
- If associated with fracture ulnar process → above elbow cast.



Hand grip method

### Rehabilitation

- Physiotherapy from 1st day to avoid Sudek's atrophy.
- Active movement (fingers – elbow – shoulder).

Active mobilization of hand & arm above head daily to prevent stiffness.

### Treatment of complications

- **Sudek's atrophy:** sympathectomy + splinting + analgesics + physiotherapy.
- **Radial a injury:** reduction of the fracture:
  - If pulse returns → follow up.
  - If no pulse (within 20 minutes) → Explore artery & repair it according to the type of injury.
- **N. injury:**
  - Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
    - If failed → explore & repair the nerve.
  - Open → mark the nerve at 1st by black silk
    - Then delayed suturing (no 1<sup>st</sup> repair).
- **Rupture of Extensor pollicis longus tendon** → transfer of extensor indices.

## Smith Fracture

### Definition

- It is the reverse of Colles' fracture.

### Etiology

- Due to fall on the dorsum of the hand.

### Displacement

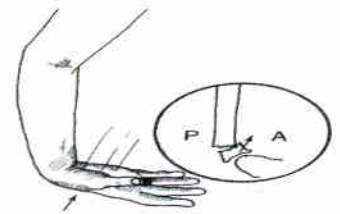
- The distal fragment is displaced anteriorly.
- Smith fracture in which the distal end of radius is ventrally displaced with radial deviation, so, in A-P radiography no difference can be detected between Smith and Colles' fracture.

### Deformity

- Garden spade deformity

### Treatment

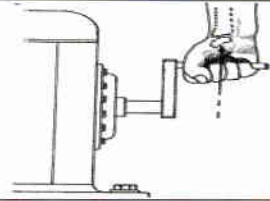
- Reduction is achieved by manipulation and is maintained by an above elbow plaster for 6 weeks or by internal fixation.
  - Intra-articular fracture is called **Barton's fracture** in which chips of the anterior portion radius is fractured.



Smith's fracture

## Fracture Styloid Process of the Radius

- It is also called **Chauffeur's fracture**.
- It is caused by manuvella which was used to start cars.
- Treatment:** Colles' cast for 6 weeks.



## Monteggia Fracture Dislocation

### Definition

= fracture upper 1/3 ulna + superior radio-ulnar joint dislocation

### Treatment

= ORIF + closed reduction of radial head

- Monteggia fracture may occur in extension & less commonly in flexion
- It may be complicated by posterior interosseous n. injury and it may be missed in children.



## Galeazzi Fracture Dislocation

### Definition

= inferior radio-ulnar joint dislocation + fracture lower 1/3 radius

### Treatment

= closed reduction of head of ulna + } Followed by ORIF of radius



## Fracture Shafts of radius & ulna

### Site

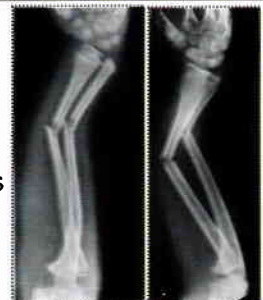
Upper, middle or lower of forearm

### Trauma

- Direct trauma → fracture both bones at same level
- Indirect trauma e.g. twisting → oblique fracture at different levels

### Displacement

- Overlap
- angulation
- side displacement
- Rotation ;
  - Above insertion of pronator teres → proximal fragment is in supination by biceps & supinator
  - Below insertion of pronator teres → proximal fragment is in midpronation.



### Complications

- Malunion, Non-union
- Synostosis "cross union"
- Acute compartment syndrome → treated by fasciotomy
- Nerve injury "uncommon"

### Treatment

- **Undisplaced** → full arm plaster cast with elbow flexion for 6-9 weeks
- **Displaced:**
  - Adults : ORIF
  - Children: closed reduction & plaster fixation

## Fracture of Scaphoid Bone

### Site

**Most common hand fracture**

- Waist of scaphoid (the commonest site).

### Trauma

- Fall on outstretched hand.

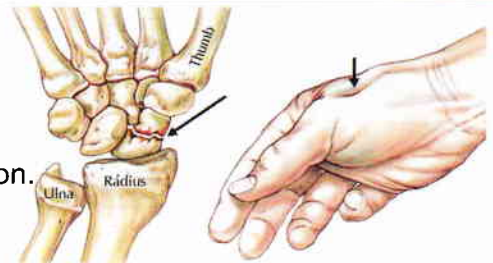
▶ **C/P:** as scheme

▶ **Invest.:** X-ray: after 2 wks (hair line)

▶ **TTT:** plaster of paris, Herbert screw

### Clinical Picture

- 1- History of trauma.
- 2- Pain in wrist with no gross impairment of function.
- 3- Tenderness below radial styloid process (in anatomical snuff box).



*Wrist function may not be impaired grossly*

### X-ray

- May not show the fracture immediately → often misdiagnosed as "wrist sprain".
- May be informative after 2 weeks →
  - As the fracture is hair line which is usually missed and difficult to interpret, but 2 weeks decalcification around fracture line rendering it more evident.
  - If there is still doubt → isotope bone scan or MRI.

### Complications

- 1- Non-union (as it's completely intra-articular)
- 2- Avascular necrosis (of proximal fragment) due to interruption of blood supply (The blood supply to the scaphoid comes from distal to proximal)
- 3- Sudeck's osteoporosis
- 4- Wrist stiffness

### Treatment

We treat the patient on clinical grounds even if the X-ray is negative → which is repeated 2 weeks later.

- 1- **Plaster of paris** (below elbow with **abducted thumb**) for 6 weeks
- 2- **Internal fixation with screw (Herbert screw)**
- 3- **Treatment of complications:**  
E.g. avascular necrosis → bone graft & internal fixation.





## Kienbock's disease:

### Definition

- Avascular necrosis of lunate bone

### Incidence

- 2/3 in the dominant hand due to single blood supply to lunate bone (congenital theory).

### Treatment

- Once occurred, surgery can't cure the condition totally.

## Bennet's Fracture

- It is a fracture dislocation of the 1<sup>st</sup> metacarpal.

## Fracture of the phalanges

- These are often transverse and the fragments are often angulated forwards by the tension of the lumbrical and interosseous muscles.
- The angulation is corrected and the finger is immobilized in semiflexion over a finger wire splint incorporated in a forearm plaster cast.



# Lower Limb

## Fracture Pelvis

### Definition

- It's the fracture of the pelvic ring with or without soft tissue injury.

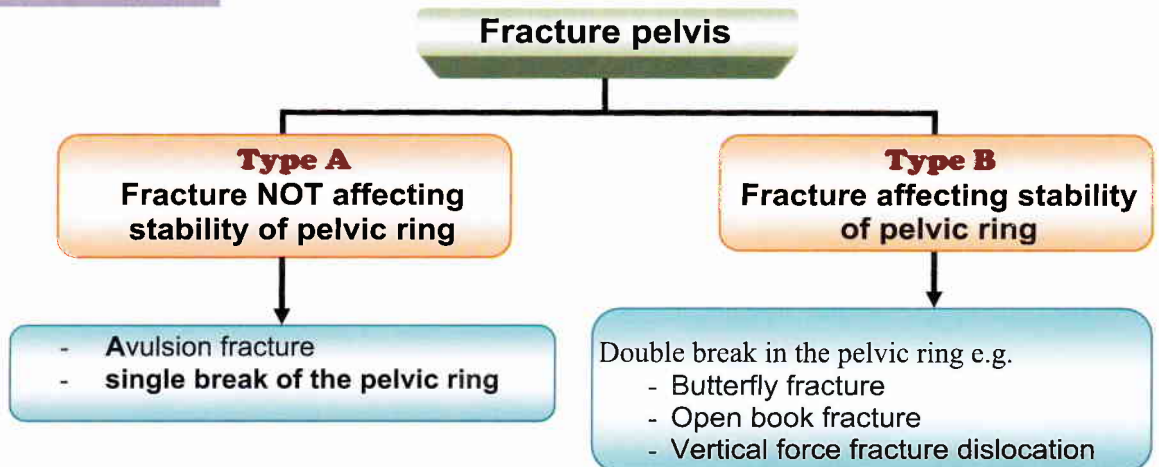
### Incidence

- Common with major trauma
- 3% of all fractures

### Trauma

- Direct: A-P Compression or lateral Compression.
- Indirect: vertical shear.

### Classification



### A) Fracture NOT affecting stability of pelvic ring

(Low energy injuries)

- Avulsion fracture
- single break of the pelvic ring

#### Avulsion fracture:

Results from sudden violent muscular contraction: e.g. epilepsy

- Fracture A.S.I.S. with sartorius violence.
- Fracture A.inferior.I.S. with rectus femoris violence.

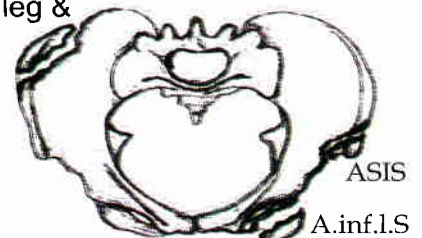
#### Diagnosis:

- History of trauma - acute pain - the pt. can lift his leg & can stand on it.
- on examination: Bruises - localized tenderness.

#### X-ray:

- Fracture line.
- Be sure that sacroiliac joint is undamaged.

**Treatment:** → Bed rest & Analgesics for 6 wks.



Avulsion fracture

## B) Fracture affecting stability of pelvic ring

### ➤ Incidence:

- uncommon
- High energy injuries → high mortality
- Associated with other major injuries in 65%

### ➤ Trauma & displacement:

- Butterfly fracture (Compression force fracture → double break in anterior segment with posterior displacement of central segment).
- Open book fracture (Hinge force fracture → wide separation of the symphysis pubis with little separation of one of sacroiliac joint).
- Vertical force fracture dislocation: 3 subtypes:
  - 1- **Dislocation of symphysis pubis & sacro-iliac joint** with upward displacement
  - 2- **Malgaigne fracture**: unilateral double pelvic fracture with upward dislocation i.e. fracture both pubic rami with fracture ileum.
  - 3- **Total pelvic disruption** = Bilateral pelvic ring fracture.



Butterfly fracture



Open book fracture



Malgaigne fracture



Dislocation of symphysis  
pubis & sacro-iliac joint

## Diagnosis

### History

- Trauma.
- Swelling.
- Disturbance of function (inability to stand up or move the pelvic ring)
- Inability to pass urine.
- Pain.

### Examination

- **General:**
  - Shock.
  - Other injuries.
  - Retro-peritoneal hemorrhage may cause ileus and simulates visceral injury
- **Local:**
  - **Inspection:**
    - Ecchymosis, bruises, swelling
    - Shortening of the limb.
  - **Palpation:**
    - Gap at the symphysis pubis may be felt.

- **Movements:**
  - ▶ Limitation of movements.
  - ▶ The patient can not stand or lift his legs, but passive movements at the hip may be elicited
- **Visceral injury:**
  - Uro-genital: **ask the patient to pass urine:**
    - If clear urine is passed → all is well.
    - If not & suspected urethral injury → do gentle retrograde urethrography.
  - Examine for neuro-vacular injury of the lower limb as sciatic nerve.
  - Rectal, vaginal:
    - **DRE:**
      - For associated rectal or prostatic injuries or bleeding,
      - Earle sign → large hematoma or palpable fracture line on DRE.
    - **PV:** for associated vaginal injuries.

➡ **Catheter test** (not done now as it is traumatizing).

- Rupture urethra → catheter can't pass.
- Rupture urinary bladder → catheter can pass and blood comes out.

### Complications of Pelvic Fracture

1- **Hemorrhagic shock:** Blood loss may be up to 2.5 liters.

2- **Visceral injury :**

- A. Intrapelvic urethra (membranous part) bleeding per urethra, retention of urine
- B. Extraperitoneal bladder rupture (localized tender swelling above symphysis, catheter pass easily).
- C. Injury of rectum and vagina.
- D. Paralytic ileus due to retro-peritoneal hematoma

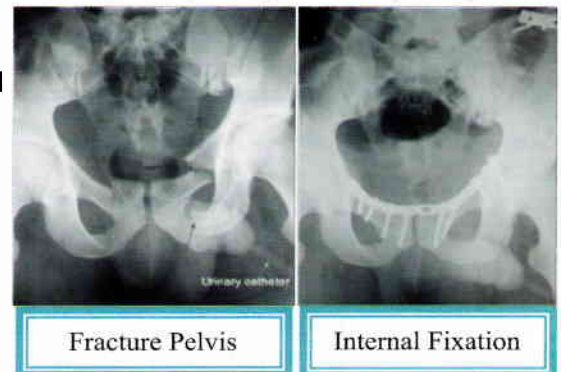
3- **Sciatic nerve injury.**

4- **DVT** from prolonged recumbency.

5- **Osteoarthritis of hip joint.**

6- **Pelvic mal-union:** Causes no significant problems except in females (cesarean section may be needed).

7- **Secondary osteoarthritis** commonly occurs after disruption of the sacroiliac joints or acetabular fractures.



### Investigations

- **X-ray:**
  - Fracture line.
  - **± Positive Obturator sign:** (it is radiographic line formed by the fat over the Obturator internus ms & gets displaced medially away from the pelvic side wall by hematoma & soft tissue swelling).
- **CT scan:**
  - For rapid evaluation of head, chest, abdomen & pelvis.
  - For associated injuries & sacral fractures.
- **U/S:** an alternative for abdominal evaluation.

**Treatment****First Aid****General → If poly-traumatized patient****A. Primary Survey**

This includes a pre-hospital phase and a hospital phase

**ABCDE****A- Airway**

- **Assessment:** if the patient is able to speak freely, his airway is patent.
- **Action:**
  1. Clear airway.
  2. Protect airway: oropharyngeal airway, tracheal intubation or cricothyroidotomy.
  3. Cervical spine control.

**B- Breathing**

- **Assessment:** inspection, palpation, percussion and auscultation (look - feel - listen).
- **Action:** e.g. Needle decompression for tension pneumothorax.

**C- Circulation**

- **Assessment:** general examination for hemorrhagic, cardiogenic or neurogenic shock.
- **Action:**
  1. Control bleeding.
  2. Restore the lost blood.

**D- Disability**

- **Assessment:** AVPU evaluation (alert, vocal, painful stimulation, unresponsive), followed by Glasgow coma scale in the secondary survey.

**E- Exposure**

- Insert Foley's catheter and nasogastric tube
- Radiological assessment
- AMPLE history (may be done in the secondary survey).

**B. Secondary Survey**

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

**Treatment of Fracture**

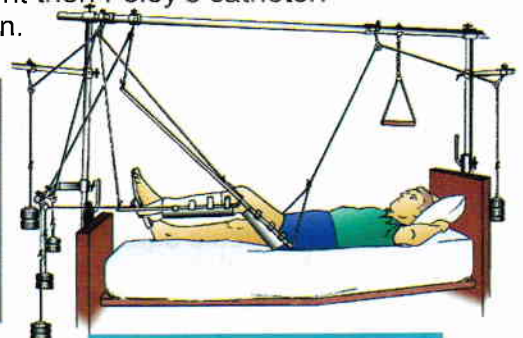
- **Not affecting the stability of pelvic ring:** bed rest & analgesics for 6 weeks.
- **Affecting the stability of pelvic ring:**
  - **Previously:** analgesics & pelvic sling
  - **Recently:**
    - External fixation systems: Consist of pins, clamps & cross bandages.
    - ORIF: better mechanically & more popular using plates & screws.

**Treatment of Complications**

- Bladder → Closure of the bladder to be water tight then Foley's catheter.
- Urethra → suprapubic cystostomy, later dilatation.
- Rectum → colostomy.



Fracture Pelvis treated by internal fixation



Skeletal traction



# Hip Dislocation

## Types

- Congenital.
- Traumatic.
  - **Posterior** dislocation (**commonest 80%**).
  - Anterior dislocation.
  - Central dislocation.
- Pathological: T.B. hip joint.
- Paralytic: e.g. with polio, CP or spina bifida.

## Normal Mechanism of Stability of Hip Joint

- **Passive:**
  - Normal anatomy (deep acetabulum).
  - Capsule.
  - -ve intra-articular pressure.
  - Ligaments: → minimal role ≠ knee joint.
- **Active:** muscle action → Tone & contraction.

## Developmental dysplasia of the hip

(Old name: congenital dislocation of hip)

### Definition

- Neonatal disorder in which the hip is dislocated either at birth or soon after birth, unless corrected it leads to permanent deformity & disability

- ▶ **Etiology:** ♀, 1<sup>st</sup> child, oligohydramnios
- ▶ **C/P:-** Neonates: asymmetrical gluteal creases
  - Infant & child: trendelenburg (unilateral) or waddling gait (bilateral)
  - Adolescent: discomfort after exercise
  - Adult: pain (osteoarthritis)
- ▶ **Invest.:** U/S, X-ray
- ▶ **TTT:** - up to 9m.: reduction in frog position
  - 9m.→5y.: skin traction then hip spica
  - >5y.: osteotomy (femoral or pelvic)

### Incidence

- 1:1000-2000

### Risk factors

- a. Female > male (hormonal joint laxity).
- b. 1<sup>st</sup> child.
- c. Breech, oligohydramnios.
- d. +ve family history of:
  - i. Developmental dysplasia of hip.
  - ii. Very flexible ligaments or joint laxity.

### Pathology

- a. The head: may dislocate laterally and upwards with delayed appearance of the ossific nucleus.
- b. The neck: anteversion may reach 90° (normally about 20°).
- c. Acetabulum: will become more shallow and sloping, inverted limbus.
- d. The soft tissues:
  - The capsule is stretched and ligamentum teres becomes elongated.
  - The capsule squeezed between the acetabulum and the psoas muscle develops an hour glass.
  - The surrounding muscles become adaptively shortened.



## Clinical Picture

(Presentation of DDH from birth to adult life)

1. **Neonates:** mother observes: asymmetry, clicking hip or difficulty in applying the napkins (due to limited abduction).

- **Special tests:**

| Ortolani                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Barlow                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>To perform this maneuver correctly,</p> <ol style="list-style-type: none"> <li><b>The patient must be relaxed.</b></li> <li><b>Only one hip is examined at a time.</b></li> <li>1-The examiner's thumb is placed over the patient's inner thigh</li> <li>2-The index finger is gently placed over the greater trochanter.</li> <li>3-The hip is abducted, and gentle pressure is placed over the greater trochanter.</li> <li>4-In the presence of DDH, a clunk, similar to turning a light switch on or off, is felt when the hip is reduced.</li> </ol> <p>d. <b>The Ortolani maneuver</b> should be performed gently, such that the fingertips do not blanch.</p> | <ul style="list-style-type: none"> <li>Barlow described another test for DDH that is performed with the hips in an adducted position, in which slight gentle posterior pressure is applied to the hips.</li> <li>A clunk should be felt as the hip subluxes out of the acetabulum.</li> </ul> |

2. **Infant and child:**

| Unilateral cases                                                                | Bilateral cases |
|---------------------------------------------------------------------------------|-----------------|
| Asymmetrical gluteal creases                                                    | Broad perineum  |
| Present with a limb (the affected leg tends to be short and externally rotated) |                 |
| Trendelenburg gait (after walking)                                              | Waddling gait   |

3. **Adolescent:** discomfort after exercise (X-ray may show dysplasia and possibly subluxation)

4. **Adult:** pain is the usual complaint as a result of degenerative osteoarthritis (X-ray may show dysplasia or degenerative changes).

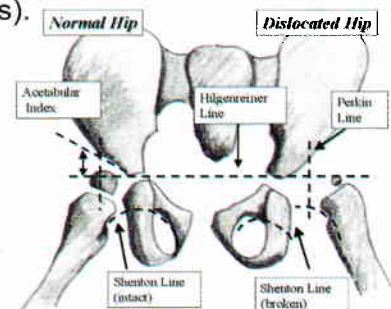
## Investigations

1. **U/S:**

- Has been of significant benefit in the assessment and treatment of children with hip dysplasia (used to confirm and monitor hip stability and as screening test between 4-6 weeks particularly in at risk patients).

2. **X-ray:**

- Of little value before the age of 1 yr. old as the head of femur is cartilaginous till this age.
- At the age of 1 yr or older:
  - Shallow acetabulum.
  - Ossification center of the head is displaced upwards & outwards.



## Treatment

### a) Newborn:

- Most of neonates with instability sign at birth, spontaneously corrected, so it is better to wait till weeks 3 weeks before intervention.
- After 3 weeks → reduction & splinting in abduction.
- If U/S confirm the diagnosis of CHD → VonRosen splint for 3 – 6 months is a must.



### b) Discovered at the age of 6 months – 6 years:

- Reduction in plaster cast with maintained abduction for 6 wks.
- After 6 wks → replace the cast with splint that prevent adduction but allow movement.
- Follow up by serial X-ray films.
- If failed reduction → surgery is performed either:
  - Open reduction followed by fixation by plaster cast Or if the acetabulum is markedly shallow, it can be deepened by a concomitant pelvic osteotomy.

### c) Discovered after the age of 6 years:

- Unilateral dislocation → operative reduction + corrective osteotomy.
- Bilateral dislocation:
  - Painless not noticed waddling → better to avoid operative reduction.
  - If there is noticed waddling → operative reduction + corrective osteotomy

## Traumatic Hip Dislocation

### a) Posterior Dislocation (80%)

#### Types

- Pure dislocation: if hip flexed & adducted during trauma.
- Fracture dislocation: if hip is flexed only during trauma.
- Missed dislocation: if associated with fracture femur or tibia on the same side.

- ▶ **Etiology:** forced flexion + adduction + int. rotation
- ▶ **C/P:** as scheme + supratrochanteric shortening + Narthe's sign
- ▶ **Comp.:** as scheme + avascular necrosis of femoral head + sciatic n. injury
- ▶ **Invest.:** X-ray, CT
- ▶ **TTT:** reduction & fixation (open, closed)

#### Trauma

- **Forcible flexion + adduction + internal rotation.**
  - Dash board accident in person who is cross legged.
  - Fall of heavy object on back of stooping individual.

#### Displacement

- Sciatic or ischeal.

#### Clinical Picture

#### Symptoms

- History of trauma.
- Pain.
- Swelling.
- Inability to stand or walk (disturbance of function).



## Signs

### 1) Inspection

- Ecchymosis , bruises , swellings
- Lower limb is **flexed, adducted** and **internally rotated**.
- **Supratrochanteric shortening** (shortening with fixed greater trochanter-condyle distance).

### 2) Palpation

- Femoral head palpated post. empty femoral  $\Delta$ .
- **Narthes sign** (i.e. Difficulty to palpate femoral pulse due to backward migration of femoral head).

### 3) Movement

- Painful limitation of all hip movements.

### 4) Neurovascular evaluation :

- Sciatic n. injury →
  - a. Motor: drop foot.
  - b. Sensory loss:
    - Back of thigh
    - The leg & foot (except small area on the medial aspect)



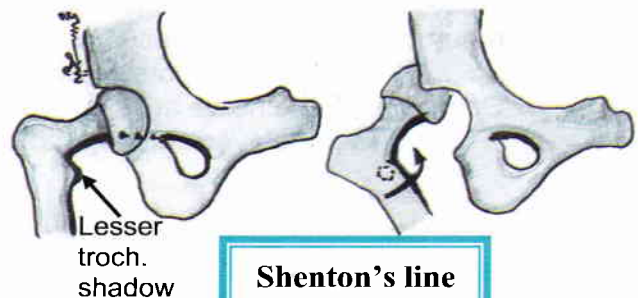
## Complications

### General

- Neurogenic shock.
- Complications of prolonged recumbancy e.g. DVT & pulmonary embolism.

### Local

- **Sciatic nerve injury:** Either immediate, post reduction or post operative.
- **Bone complications:**
  - Associated fracture acetabulum.
    - Small fragment → falls in place with reduction so, traction for 6 wks.
    - Large fragment → int. fixation with screw.
  - Avascular necrosis of femoral head especially if reduction is delayed.
- **Joint complications:**
  - Irreducible dislocation may be due to:
    - Fracture fragments entangled inside the joint.
    - Button holing effect of capsule injury.
  - Early arthritic changes.
  - Joint Stiffness may be due to:
    - Avascular necrosis of head of femur.
    - Neglected dislocation e.g.: in comatosed patient.
    - Myositis ossificans.



## Investigations

### - X-ray (A-P view)

#### Confirm the diagnosis:

- Displaced femoral head.
- Empty acetabulum.
- **Interrupted Shenton's line** (a regular arcade formed by the lower border of femoral neck & upper border of obturator foramen).



**Associated fracture:**

- Disappearance of shadow of lesser trochanteric due to internal rotation.
- Loose intra-articular fragment may be detected.

- **CT scan → Essential**

- Evaluate intra-articular structures & femoral head.
- Confirm reduction.

**Treatment**

- **Emergent reduction:**

⇒ **Aims:**

- Relief pain, relief pressure on sciatic nerve.
- ↓ Risk of avascular necrosis of femoral head.

⇒ **Methods:**- **Closed**➤ **Allis method:**

- GA & muscle relaxant.
- Patient lies on blanket on the floor.
- Assistant steadies the pelvis.
- Surgeon:
  - Flex hip & knee to 90°
  - Pulls the thigh vertically upwards at same time → lat. rotation of femur.
  - Once click is observed → limb is extended

- Open → if closed reduction failed i.e. associated fracture acetabulum.

**Immobilization**

- Skin traction (6 wks).

**After Care**

- Neurological assessment of sciatic n. (If affected → CT then explore).
- Early motion → but delay weight bearing 3 months.
- Follow up (2 years) for:
  - Arthritic changes.
  - Avascular necrosis of femoral head.

**Treatment of Complications**

- **e.g. Sciatic nerve injury:**

- Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or Axonotmesis)
  - If failed → explore & repair the nerve.
- Open → mark the nerve at 1st by black silk
  - Then delayed suturing (no 1<sup>st</sup> repair).



## B) Anterior Dislocation

### Trauma

- Forcible abduction and external rotation in flexed hip.

### Clinical Picture

### Symptoms: (as before)

### Signs

#### 1. Inspection

- Limb is slightly **flexed, abducted & externally rotated**.
- May be **lengthening**.

#### 2. Palpation:

- Head may be felt over pubic bone or in perineum.

#### 3. Movement: impaired.

- ▶ **Etiology:** forcible flexion + abduction + ext. rotation
- ▶ **C/P:** as scheme + longer limb
- ▶ **Comp.:** as scheme + avascular necrosis + obturator / femoral n. injury
- ▶ **Invest.:** X-ray, CT
- ▶ **TTT:** reduction + skin traction (Thomas splint)



### Types

- **Obturator:** If hip is flexed during trauma (more common).
- **Pubic:** If hip is extended during trauma.

### Complications

- Avascular necrosis.
- Injury of femoral & obturator nerves and vessels.
- Injury of femoral vessels.



### Investigations

- **X-ray & CT:**
  - Confirm the diagnosis + associated fracture (+lateral view is recommended).

### Treatment

- Reduction under GA (allis method or internal reduction).
- Skin traction 3 wks by Thomas splint.
- After treatment as before.

## C) Central Dislocation

### Mechanism

- Due to direct trauma to greater trochanter → drive femoral head inward → fracture of floor of acetabulum.

### Clinical Picture

- Severe pain.
- Flat trochanteric area.
- Short limb.
- But the trochanter is not raised above Nelaton's line.
- It is always associated with visceral injury.



### Subtypes & Treatment

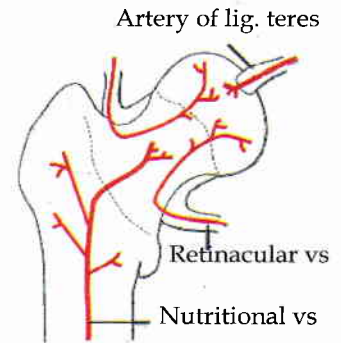
- **Minimal displacement of femoral head:**
  - Skeletal traction 3 wks → active exercise or passive motion machine.
- **Dislocation of femoral head into the pelvis:**
  - Open reduction + primary total hip replacement.



# Fracture Neck Femur

## Blood Supply of Femur Head & Neck

- 1- Extra capsular arterial ring:**
  - Present at the base of the neck formed by branches of medial & lateral circumflex femoral arteries (from profunda femoris)
- 2- Retinacular vs:**
  - Arising from the extra capsular ring & penetrate the capsule to be subsynovial.
- 3- Artery of ligamentum teres:**
  - Usually arise from obturator artery.
  - Fully developed at 8th years (absent in 15% of cases).
- 4- Nutritional vessels:**
  - From the shaft along the medulla



**Neck shaft angle** =  $130 \pm 5^\circ$

**Angle of femoral torsion (anteversion):** the plane of neck declines anteriorly about  $15^\circ$  than the plane of shaft.

## Intra-capsular Fracture of Neck Femur

### Incidence

- Old age > young due to senile osteoporosis.
- ♀ > ♂ due to postmenopausal osteoporosis (most important).
- In adolescent age → slipped upper femoral epiphysis.
- Pathological fracture can occur from secondaries.

- ▶ **Etiology:** old ♀, when foot catches a carpet
- ▶ **C/P:** - Impacted: only tenderness (missed)
  - Unimpacted: as scheme + ext. rotation, adduction, short limb, -ve leg raising test
- ▶ **Comp.:** general, local (avascular necrosis, sciatic n. injury)
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma +
  - **Impacted:** internal fixation
  - **Displaced:**
    - < 65 y.: closed reduction by int. fixation or ORIF
    - > 65 v.: hemiarthroplastv

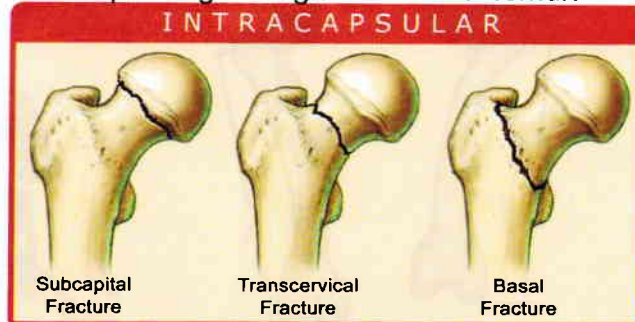
### Trauma (mechanism of injury)

- Elderly pt. → minor trauma:
  - As when foot catches the edge of a carpet → **Intracapsular fracture.**
  - Direct fall over greater trochanter.
- Young patient or old → major trauma.

## Classification

### According to Site

- **Intracapsular:** (the proximal fragment often loses part of its blood supply)
  - **Sub-capital** → just below femur head.
  - **Trans-cervical** → passing through the neck of femur.



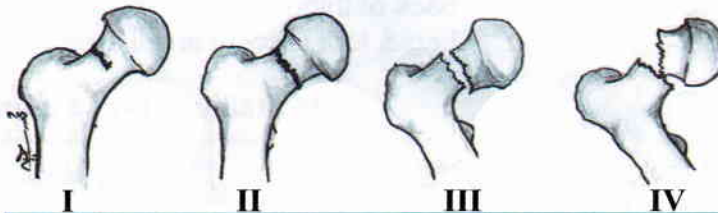
### According to displacement

- Impacted.
- Unimpacted (displaced).

### Garden Classification of Intracapsular Fractures

(According to the appearance of the hip on A-P x-ray)

- Type I: incomplete fracture (abducted or impacted type)
- Type II: complete fracture without displacement or impacted.
- Type III: complete fracture with partial displacement.
- Type IV: complete fracture with full displacement.



Garden Classification of Intracapsular Fractures

## Clinical Picture

### Impacted

- Usually no rotation, the lower limb appears to be abducted rather than adducted with only tenderness over fracture site (missed fracture).

### Unimpacted Fracture

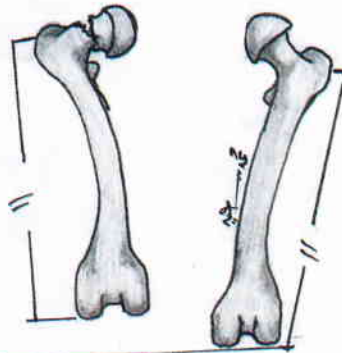
#### ▪ Symptoms:

- History of trauma.
- Pain in hip region → refers to groin & medial side of knee.
- Swelling in hip region.
- Inability to walk (even inability to get up after falling).

#### ▪ Signs

- Inspection:
  - Ecchymosis over the greater trochanter (**more in extracapsular type**)

- Deformity →
  1. External rotation.
  2. Adduction.
  3. Shortening of the limb



Supratrochanteric shortening



- Palpation:
  - Tender greater trochanter & raised.
- Movement (straight leg raising test):
  - Inability to raise extended leg.
  - Movements of the hip are painful.
- Neurovascular:
  - Sciatic n. injury:
    - a. Drop foot.
    - b. Sensory loss → - back of thigh.
  - Leg & foot (except small area on medial aspect).

## Complications

Mortality in first 3 month is 20%

### General

- Complications of prolonged recumbency:
  - DVT & pulmonary embolism in 25% of cases.
  - Bed sores.
  - Osteoporosis.
  - Renal stones.
  - Constipation.

### Local

- **Avascular necrosis (most common):15-35%**
  - ➔ **Cause:** occurs in **intra-capsular type** (not in extra-capsular) due to cut of blood supply of femoral head causing its necrosis & mal-union.
  - ➔ **X-ray:** head will become denser then shrinks
  - ➔ **Sequale:** 1- Delayed or even non-union  
2- 2ry osteoarthritis.
- **Non-union :**
  - Cause:** Cutting of blood supply, Imperfect reduction, and Imperfect fixation.
- **Mal-union:**
  - More with extracapsular fracture.
  - Coxa vara < 120°                      - Coxa vulga > 120°
- **Neurovascular injury → sciatic n. injury.**

▪ **Other complications:**

- Skin → tear, blisters & necrosis.
- Muscles & tendons → tear.
- Osteoarthritis & stiffness of **hip** joint (on longstanding cases).
- Limb shortening.

## Investigations

▪ **X-ray:**

"A-P with internal rotation. 15 °" (To mask the angle of anteversion in order to make the plane of neck perpendicular to x-rays).

1. Fracture.
2. Osteoporosis.



## Treatment

- If a part of poly-traumatized patient → **ABCD** then **R&M**.

### A. Impacted fractures

- No reduction is required. Internal fixation, preferably with 2 cannulated screws.

### B. Displaced fractures

1. Patient under 65 years old. Closed reduction by internal fixation as above. If satisfactory closed reduction can not be obtained, open reduction should be obtained.
2. Patient above 65 years old. The treatment of choice is replacement of the head and neck of the femur with a metal prosthesis (hemiarthroplasty) because the incidence of non-union or avascular necrosis is high.

### C. Postoperative

- In all cases, the patient should be ambulated once the general condition allows.

### D. Treatment of Complications

- Established avascular necrosis → Austin Moore replacement or total hip replacement if there's **O.A. of the hip**.
- Non-union:
  - Young age with viable head → subtrochanteric displacement osteotomy
  - Old age or young with non viable head → prosthesis.
- Mal-union → corrective osteotomy.
- N. injury:
  - Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis).  
If failed → explore & repair the nerve.
  - Open → mark the nerve at 1<sup>st</sup> by black silk.  
→ Then delayed suturing (no 1<sup>ty</sup> repair).
- Open fracture → antibiotics + external fixation.



inter-trochanteric fracture treated by internal fixation



Impacted femoral neck fracture treated by internal fixation with 3 parallel lag screws



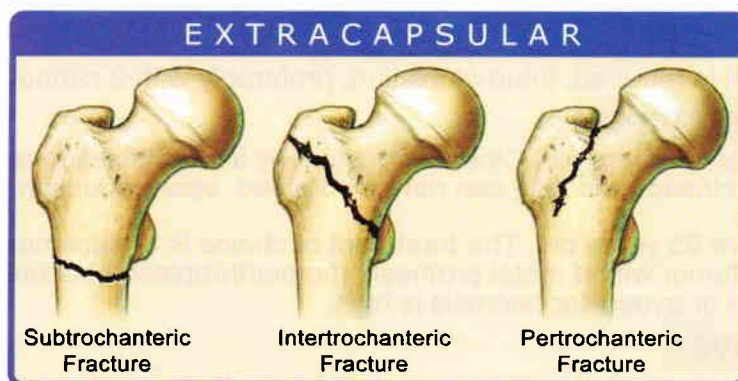
displaced femoral neck fracture treated by femoral head replacement with a prosthetic device.



# Extra-capsular Fracture of Neck Femur

- ▶ **C/P:** as scheme + ext. rotation, short limb, patient can't raise his leg
- ▶ **Comp.:** thromboembolism, malunion
- ▶ **TTT:** - **Trochanteric:** ORIF by DHS
- **Subtrochanteric:** I.F. (plate & screws)

- **Inter-trochanteric** → connects the 2 trochanters together.
- **Per-trochanteric** → passing in the space between the 2 trochanters.
- **Trochanteric** → fracture of greater or lesser trochanter.
- **Subtrochanteric** → within 5 cm below intertrochanteric line.



## Mechanism of injury and morbid anatomy

- ➡ In young persons trochanteric and subtrochanteric fractures are usually the result of major trauma. In the elderly trochanteric fractures may occur secondary to a fall on the side producing a blow over the greater trochanter.
- ➡ Extracapsular fractures differ from intracapsular ones in 2 aspects:
  1. The blood supply of the two fragments is good and so avascular necrosis and non-union do not occur.
  2. The operative treatment is not mandatory.

## Clinical features

- 1- External rotation or 90 degree and shortening of the limb.
- 2- Tenderness over the fracture site.
- 3- Inability of the patient to raise his leg.

## Complications

- 1- Thromboembolism.
- 2- Malunion leading to shortening, adduction and external rotation.

## Treatment

- a) Trochanteric fractures ORIF by (DHS)
- b) Subtrochanteric fractures are treated by internal fixation by plate and screws.



# Fracture Shaft Femur

## Site

- Subtrochanteric.
- Mid shaft.
- Supracondylar (more in adults).

- ▶ **C/P:** as scheme + subtrochanteric shortening
- ▶ **Comp.:** as scheme + shock, injury of (femoral a., popliteal A.&N.) knee stiffness\*
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma + ORIF. (If mid shaft in young patient → Crede's method or Gallow's traction)

|                   | Subtrochanteric                                                                                                                                                             | Mid shaft                                                                                                         | Supracondylar                                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Site              | - 5 cm below inter trochanteric Line.                                                                                                                                       | - In between.                                                                                                     | - 9 cm above femoral condyles.                                                                                              |
| Displacement      |                                                                                                                                                                             |                                                                                                                   |                                                                                                                             |
| Proximal fragment | - Abduction by <u>glutei.</u><br>- Fixation by iliopsoas                                                                                                                    | - Forward → by <u>quadriceps.</u>                                                                                 | - Forward by <u>quadriceps.</u>                                                                                             |
| Distal fragment   | - Adduction by <u>adductors.</u><br>- Up by → <u>quadriceps.</u><br><u>hamstring.</u><br> | - Backward → by hamstring.<br> | - Backward by <u>gastrocnemius.</u><br> |

## Classification & Trauma

- Spiral (if indirect trauma).
- Transverse (if pathological fracture).
- Comminuted (if direct trauma).

## Clinical Picture

### Symptoms

- History of trauma.
- Pain.
- Swelling.
- Inability to move the limb.

### Signs

- **General:**
  - **Shock** → may be severe patient may loose 1-2 liters of blood.
  - Associated injuries.
- **Local:**
  - **Inspection:**
    - Ecchymosis and bruises.
    - Swelling.
    - Subtrochanteric shortening.
    - 5 -15% are open fractures.
  - **Palpation:**
    - Tenderness.
    - Crepitus.
  - **Movement:**
    - Abnormal range of mobility.
  - **Neurovascular evaluation:**
    - Blood vessel injury:
      - Femoral artery in mid shaft fracture.
      - Popliteal artery in supracondylar fracture.
- **Nerve injury:** lateral popliteal nerve in supracondylar fracture.

## Complications

### General

- Shock.
- Complications of prolonged recumbency e.g. bed sores.
- Fat embolism.

### Local

- **Blood vessel injury:**
  - Femoral artery in mid shaft fracture.
  - Popliteal artery in supracondylar fracture.
- **Nerve injury:** lateral popliteal nerve in supracondylar fracture.
- **Fracture:**
  - Non-union and mal-union.
  - Infection.
- **Joints:** stiffness of knee (commonest).
- **Muscles:**
  - Myositis ossificans.(especially vastus intermedius)
  - Volkmann's ischemic contracture.
  - Tear.
  - **Skin:** in open fractures. - Infection.



## Investigations

- X-ray

## Treatment

### First Aid

### General → If poly-traumatized patient

#### C. Primary Survey

This includes a pre-hospital phase and a hospital phase

## ABCDE

### F- Airway

- **Assessment:** if the patient is able to speak freely, his airway is patent.
- **Action:**
  4. Clear airway.
  5. Protect airway: oropharyngeal airway, tracheal intubation or cricothyroidotomy.
  6. Cervical spine control.

### G- Breathing

- **Assessment:** inspection, palpation, percussion and auscultation (look - feel - listen).
- **Action:** e.g. Needle decompression for tension pneumothorax.

### H- Circulation

- **Assessment:** general examination for hemorrhagic, cardiogenic or neurogenic shock.
- **Action:**
  - a. Control bleeding.
  - b. Restore the lost blood.

### I- Disability

- **Assessment:** AVPU evaluation (alert, vocal, painful stimulation, unresponsive), followed by Glasgow coma scale in the secondary survey.

### J- Exposure

- Insert Foley's catheter and nasogastric tube
- Radiological assessment
- AMPLE history (may be done in the secondary survey).

#### D. Secondary Survey

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

## Treatment of Fracture (Limb Saving)

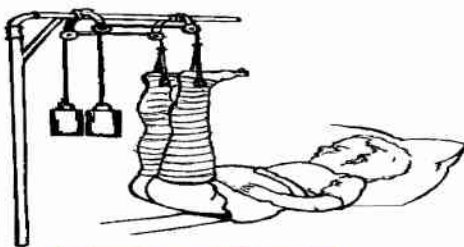
| Subtroch.                                                                                                                               | Mid shaft                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Supracondylar                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ORIF by:</b> <ul style="list-style-type: none"> <li>• Condylar plate 95°.</li> <li>• Interlocking nail.</li> <li>• Screw.</li> </ul> | <b>Open fracture</b> <ul style="list-style-type: none"> <li>• Debridement + antibiotics.</li> <li>• Reduction.</li> <li>• Fixation → external skeletal fixation.</li> </ul> <b>Closed fracture</b> <ol style="list-style-type: none"> <li>1- <u>Newborn:</u> <ul style="list-style-type: none"> <li>- <b>Crede's method</b> (femur reduced and fixed by tongue depressor and thigh flexed on abdomen and fixed to it for 2 weeks by adhesive plaster).</li> </ul> </li> <li>2- <u>Infants (&lt; 4 yrs):</u> <ul style="list-style-type: none"> <li>- <b>Gallow's traction</b> (4-6 wks) (traction is just enough to raise the buttocks from bed).<br/><b>N.B.:</b> Child wt. should be less than 12 kg.</li> </ul> </li> <li>3- <u>Children (5-15 yrs):</u> <ul style="list-style-type: none"> <li>- Reduction.</li> <li>- Fixation → <b>skin traction + Thomas splint</b></li> <li>- Then hip spica.</li> </ul> </li> <li>4- <u>Adults</u> → ORIF               <ol style="list-style-type: none"> <li>a. <b>Oblique fracture:</b> → Interlocking nail.</li> <li>b. <b>Transverse fracture</b> → Intramedullary nail.</li> <li>c. <b>Comminuted fracture</b> → Interlocking nail</li> </ol> </li> </ol> <ul style="list-style-type: none"> <li>• less commonly skeletal traction</li> </ul> | <b>ORIF by:</b> <ul style="list-style-type: none"> <li>• Condylar plate 95°</li> <li>• Interlocking nail.</li> <li>• Buttress plate.</li> </ul><br><b>NB: Buttress plate</b><br>(comminuted fracture). |

### Disadvantages of conservative treatment (traction):

1. Prolonged immobilization with all its side effects especially in elderly persons.
2. Liability to stiffness of the knee.
3. Reduction may be impossible if there is soft tissue interposition between the fragments.
4. Difficulty in adjusting ideal traction. Excess traction may lead to ditraction.
5. Lateral popliteal n. injury due its compression by Thomas splint.

### Treatment of complications

- Non-union → rigid fixation & bone graft.
- Mal-union → osteostomy & internal fixation.
- Infection → debridement & antibiotics.



Gallow's traction



Plate & screw



Interlocking nail

Fracture 9 cm above femoral condyles is called  
**"Distal femoral fracture"**

#### > Types:

1. Extra articular "supracondylar fracture" → retrograde intramedullary nail or plate and screws followed by early mobilization of the knee.
2. Partial articular " unicondylar fracture".
3. Complete articular = bicondylar = T or Y fracture → compression plate system.



- This fracture is liable to be followed by osteoarthritis of the knee.
- The use of intramedullary rods in diaphyseal fractures allows early weight bearing and minimal immobilization.

### Fracture-separation of lower femoral epiphysis

In an adolescent, the lower femoral epiphysis may be displaced.

#### ➤ Complications:

1. Injury of the popliteal artery.
2. Interference with growth from damage of the growth plate may occur.

#### ➤ Treatment:

the displacement is corrected under G.A. and the position is maintained in plaster of Paris for 6 weeks.

## Fracture Patella

### Functions of Patella

- Extensor mechanism.
- Protection of femoral condyles.
- During movement, protect the tendons.

(So, try to conserve as far as possible)

### Incidence

- Adults > children.

- ▶ **C/P:** as scheme + no knee extension
- ▶ **Comp.:** knee effusion & osteoarthritis
- ▶ **Invest.:** X-ray
- ▶ **TTT:** - transverse: ORIF
  - Comminuted: patellectomy
  - Fissure: above knee cast

### Trauma

- Avulsion trauma → transverse fracture "either undisplaced or displaced"
- Direct trauma → comminuted fracture.

| Displaced Transverse fracture                                                                                                                                                                                                 | Undisplaced Transverse fracture<br>(Subperiosteal fracture)                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Avulsion trauma "sudden violent contraction of quadriceps"</li> <li>- Fracture is transverse &amp; separated.</li> <li>- Lost extensor mechanism, so no active extension.</li> </ul> | <ul style="list-style-type: none"> <li>- Less severe trauma</li> <li>- Fracture is transverse with no separation of bone fragments.</li> <li>- Intact extensor mechanism.</li> </ul> |



#### ▪ Comminuted fracture

- **Partial fragmentation:** treatment by partial patellectomy.
- **Total fragmentation:** treatment by total patellectomy & repair of quadriceps → Expansion & suture to tibial tuberosity.

## Clinical Picture

### Symptoms

- History of trauma, pain, swelling.
- Inability to extend the knee (in separated type)

### Signs

- **Inspection:** ecchymosis, bruises and swelling.
- **Palpation:** tenderness, crepitus, feel fracture fragments, knee effusion.
- **Movement:** active extension is lost (in transverse type).
- **Soft tissue:** evaluation of ligamental injury.
- **Hemarthrosis**

## Complications

- **Non union due to:**
  - Distraction of fragments.
  - Soft tissue interposition.
  - Traumatic knee effusion & hemarthrosis.
- **Delayed osteoarthritis of knee.**
- **Stiffness of the knee.**

## Investigations

- **X-ray:**
  - Different types.
  - A-P view, lateral view, skying view.

## Treatment

- **Transverse:** ORIF by tension band wiring technique.



Cannulated screw can be used instead of the tension band wiring technique

- **Comminuted:** patellectomy and reconstruction of extensor mechanism
- **Fissure:** above knee cast for 6 weeks (with knee joint in extension)

# Fracture of the Tibial Plateau

## Site and incidence

- Lateral plateau is more affected than the medial plateau.

## Complications

- Early knee arthritis.

## Treatment

- Undisplaced → cast.
- Displaced → ORIF (especially in young adults).

## Extensor mechanism injury

- It results from trauma to knee while quadriceps femoris is contracting
- Location of injury varies with patient age:
  - Elderly: injury is usually above patella
  - Middle age: fracture patella
  - Young age: patellar ligament injury

### Complications

- Delayed union & non-union "up to 20% of cases"
- Malunion
- Vascular injury
- Joint stiffness
- Skin injury
- Infection in compound fracture
- Compartment syndrome

### Treatment

If a part of polytraumatized patient → **ABCD** then **R & M**.

- Closed reduction & plaster fixation when stable reduction is possible.
- Skeletal traction through lower end of tibia when stable reduction is possible by pop alone.
- External skeletal fixation in compound fracture.
- Internal fixation with compression plate as intramedullary nail in multiple fractures
- Treatment of complications: e.g. Compartment syndrome → fasciotomy.

## Injuries of the knee joint

### I- Meniscus tears

#### Function of knee menisci

1. Increase stability of the knee
2. Control complex rolling & gliding action of the joint
3. Distribution load during movement

#### Trauma

- Twisting strain on flexed knee

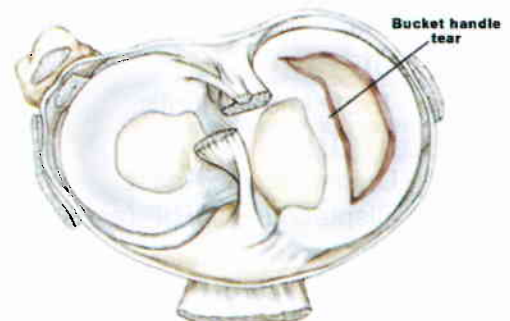
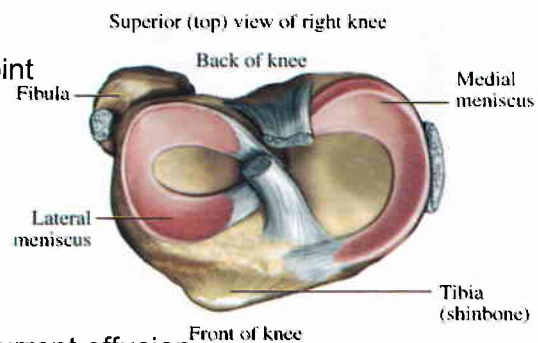
#### Clinical picture

#### Symptoms

- History of knee injury
- Can't resume game but can walk to home
- Complain of locking of the knee joint with recurrent effusion

#### Signs

- Knee effusion
- Incomplete knee extension when it's locked
- Tenderness on joint line medially
- atrophy of quadriceps in chronic patient
- **+ve McMurray's sign**  
Click is elicited when the knee is rotated in certain degree of flexion



#### Investigation

- Plain X-ray
- MRI "**most reliable**"
- Arthroscopy (**diagnostic & therapeutic**)

## Treatment

- **Conservative:** If there is no lock knee  
Rest, compression, NSAID, quadriceps exercise
- **Operative:**
  - **Indication:**
    - Joint can't be unlocked
    - Recurrent
  - **Operation:** Meniscectomy
  - **Postoperative:** quadriceps exercise

## II- Knee ligament injuries

- Two types of injuries : Cruciate & collateral ligament

### Injuries of cruciate ligament

ACL prevent sliding of the tibia forward while PCL prevent the opposite movement

## Trauma

- ACL → Sudden twist movement
- PCL → Blow in front of the knee

## Clinical picture

### Symptoms

- May not cause pain
- Leg may collapse on standing as there is instability

### Signs

- Swelling & tenderness
- Abnormal mobility

## Investigation

- Plain X-ray
- MRI
- Arthroscopy

## Treatment

**Conservative:** As meniscus injury

### Surgery:

- Reconstruction surgery for the ACL by a segment of another larger ligament "Patellar ligament"
- Postoperative physiotherapy is essential

### Injury of collateral ligament

- Due to excessive valgus or varus movement
- MRI is Diagnostic
- Treatment mainly conservative as Meniscal injury



### **Osgood - Schlatter disease (tibial tubercle epiphyseal traction injury):**

- It is irritation of patellar ligament by tibial tuberosity



# Fracture Both Leg Bones

## Site & incidence

- Both bones are fractured; rarely the tibia or fibula may be fractured alone
- Fracture is commonly open due to subcutaneous position of the tibia.

## Trauma

- Direct** e.g. road traffic injury.
- Indirect** e.g. twisting movement.

## Displacement

- To any direction according to the direction & severity of trauma.

## Clinical Picture

### Symptoms

- History of trauma.
- Pain.
- Swelling.
- Inability to move the affected limb or to bear weight on it.

### Signs

- Inspection:** ecchymosis, bruises and swelling.
- Palpation:** tenderness, crepitus.
- Movement:** abnormal range of mobility.
- Neuro-vascular evaluation:** tibial nerves & vessels.

## Complications

- Scheme + compartment syndrome.

## Investigation X-ray

## Treatment

- ABCD then R&M for poly-traumatized patient.
- Treatment of fracture according to type
  - ✓ **Transverse:**
    - Stable: → conservative treatment by above knee cast for 10 wks.
    - Unstable or failed conservative: → ORIF by intramedullary nail
  - ✓ **Oblique or spiral:**
    - ORIF by plate & screw to submuscular surface of the tibia.
  - ✓ **Open fracture of any type:** → external skeletal fixation
- TTT of complications:** e.g. compartment \$ → decompression (fasciotomy).

- ▶ **Etiology:** direct, indirect trauma
- ▶ **C/P:** as scheme + inability to move the limb
- ▶ **Comp.:** as scheme + compartment \$
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma +
  - *Transverse stable:* above knee cast
  - *Open fracture:* ext. skeletal fixation
  - *Others:* ORIF



# Ankle fractures

## Fracture & fracture dislocation of the ankle

### Anatomy

- The ankle joint is between fibula, tibia & talus;
- Supported by a complex ligamentous system (e.g. deltoid ligament).

### Definition

- Fracture lower end of tibia & fibula **involving** the ankle joint.
- Most ankle fractures are produced by abnormal motion of the talus,
- Compression produces oblique fractures, and avulsion produces horizontal fractures

- ▶ **Etiology:** forcible (eversion, inversion, rotation), axial loading
- ▶ **C/P:** as scheme + inj. of tibial N. & B.V.
- ▶ **Comp.:** as scheme + Sudeck's osteodystrophy
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma +
  - Unimalleolar: below knee cast
  - Bi/Trimalleolar: ORIF

### Pott's Classification

- Unimalleolar → only one malleolus.
- Bimalleolar → medial & lateral malleoli.
- Trimalleolar → medial, lateral & posterior malleoli.

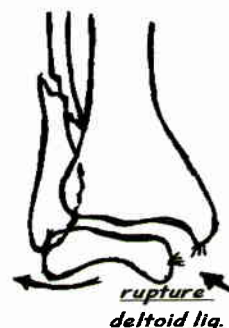
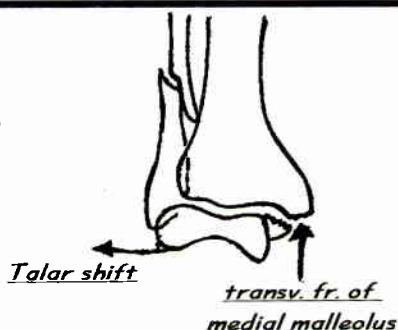
**The tarsal bone that is most prone to avascular necrosis is talus that is because there are no muscles nor tendons associated with this bone making its blood supply in somehow low.**

### Trauma

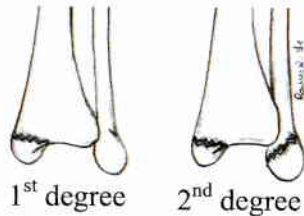
- Forcible eversion or inversion.
- Forcible rotation.
- Axial loading (falling from a height).

### Types

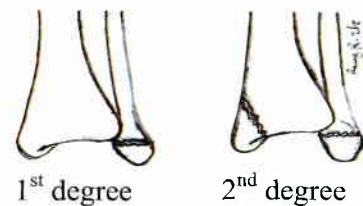
|                            | External rotation Fracture<br>(Pott's fracture)<br>(Most common)                                                                                                | Internal rotation Fracture<br>(rare)                                                                                                                            |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Trauma</b>              | Forcible external rotation.                                                                                                                                     | Forcible internal rotation.                                                                                                                                     |
| <b>1<sup>st</sup> deg.</b> | <b>Oblique</b> fracture of <u>lateral</u> malleolus.<br>No displacement                                                                                         | <b>Oblique</b> fracture of <u>medial</u> malleolus.<br>No displacement                                                                                          |
| <b>2<sup>nd</sup> deg.</b> | 1 <sup>st</sup> + rupture of deltoid ligament or<br><u>transverse</u> avulsion fracture of<br><u>medial</u> malleolus<br>+ <u>lateral</u> displacement of talus | 1 <sup>st</sup> + rupture of deltoid ligament or<br><u>transverse</u> avulsion fracture of<br><u>lateral</u> malleolus<br>+ <u>medial</u> displacement of talus |
| <b>3<sup>rd</sup> deg.</b> | 2 <sup>nd</sup> + fracture posterior margin of tibia<br>+ <u>posterolateral</u> displacement of talus                                                           | 2 <sup>nd</sup> + fracture posterior margin of tibia<br>+ <u>posteromedial</u> displacement of talus                                                            |



|                           | Abduction (eversion) fracture                                                                             | Adduction (inversion) fracture                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>Trauma</b>             | Fall on <b>everted</b> foot.                                                                              | Fall on <b>inverted</b> foot                                                                             |
| <b>1<sup>st</sup> deg</b> | <b>Transverse</b> avulsion fracture of <b>medial</b> malleolus<br>No displacement                         | <b>Transverse</b> avulsion fracture of <b>lateral</b> malleolus<br>No displacement                       |
| <b>2<sup>nd</sup> deg</b> | 1 <sup>st</sup> + <b>oblique</b> fracture of <b>lateral</b> malleolus<br>+ lateral displacement of talus. | 1 <sup>st</sup> + <b>vertical</b> fracture of <b>medial</b> malleolus<br>+ medial displacement of talus. |
| <b>3<sup>rd</sup> deg</b> | 2 <sup>nd</sup> + fracture posterior margin of tibia<br>+ posterolateral displacement of talus            | 2 <sup>nd</sup> + fracture posterior margin of tibia<br>+ posteromedial displacement of talus            |



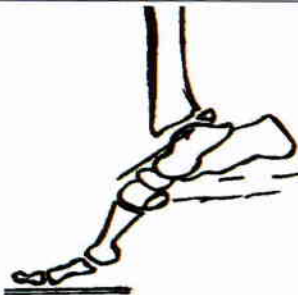
Pott's fracture in abduction



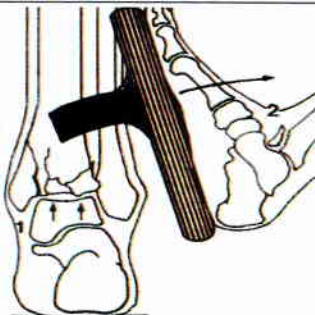
Pott's fracture in adduction

### Vertical compression fracture

| Posterior marginal fracture                                                 | Anterior marginal fracture                                                                   | Burst fracture of the ankle                                                                                            |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>Fall on planter flexed foot</b>                                          | <b>Fall on dorsi-flexed foot</b>                                                             | <b>Fall on plantigrade foot</b>                                                                                        |
| Fracture posterior margin of Tibia<br>& posterior dislocation of the ankle. | Fracture anterior margin of tibial articular surface<br>& anterior dislocation of the ankle. | Diastasis of the inferior tibio-fibular joint<br>&/or central dislocation of talus<br>& comminution of tibial surface. |



Planter flexion



Vertical impaction

### Clinical Picture

#### Symptoms

- History of trauma.
- Pain & discomfort around the ankle.
- Swelling is usually severe.
- Inability to bear weight on the affected limb.

#### Signs

- Variable deformity & tenderness.
- Neuro vascular: tibial nerve & vessels.



## Complications

- Malunion
- Non-union.
- Occasionally occurs in fractures of medial malleolus , so this fracture is always best treated by ORIF.
- Joint complications.
- Sudeck's osteodystrophy.
- Neurovascular: tibial nerve & vessels.
- Tendon injury.

## Investigation

- **X-ray:**
  - Dislocated ankle should be reduced before X-ray.
  - Fracture line.
  - Important to determine the degree.
  - Stress X-rays are very important to determine ligamentous tears.



## Treatment

### First Aid

- If poly-traumatized patient → ABCD + R & M.

### Emergency Treatment

- Trial of reduction for displaced fracture (1<sup>st</sup> step).
- Open wounds & abrasions should be cleaned.

### Definitive treatment

#### ➔ Aim: to restore

1. The anatomical position of the talus.
  2. The joint parallel to the ground.
  3. The smooth articular surface.
  4. Stability until the fracture unites by plaster cast or ORIF.
- **Stable fracture e.g. "Unimalleolar"** → Below knee plaster cast for 6 weeks
  - **Unstable fracture e.g. "bi & trimalleolar"** → ORIF of fractured malleoli by screw.
  - **comminuted** → arthrodesis
  - **compound fracture** → external skeletal fixation.



### Treatment of complications

E.g. sudeck's atrophy → sympathectomy.



# Bone Inflammation

## Classification

### Acute

- Acute Haematogenous Osteomyelitis.
- Acute Osteomyelitis secondary to open fracture.
- Acute Osteomyelitis in associated with orthopedic implants.

### Chronic

- **Non specific:**
  - Chronic osteomyelitis as a sequel to acute osteomyelitis
  - Chronic septic osteomyelitis.
  - Brodie's abscess.
  - Chronic sclerosing osteomyelitis (Garre's type).
- **Specific:** - TB. - Syphilis. - Mycotic infection.

## Acute Hematogenous Osteomyelitis

### Definition

- Acute non specific inflammation of cancellous tissue of bone & its medullary cavity.

### Incidence

- **More common in child male with low standard due to:**
  - Hyperkinetic → repeated trauma.
  - Active bone with rich blood supply at metaphysis.
  - Septic foci are common.
- There is no acute hematogenous osteomyelitis in adults but it is 2ry due to operation, open fracture or activation of latent focus.

- ▶ **Etiology:** child ♂, G+ve "staph. aureus", blood
- ▶ **C/P:** as any infection + pseudoparalysis + sympathetic effusion + ↓ active movement only
- ▶ **Comp.:** as infection + ↓ bone growth, fractures
- ▶ **Invest.:** as infection + blood culture + imaging
- ▶ **TTT:** medical "AAA" + surgical "drainage"

### Etiology

### Organism

- **Gm +ve:**
  - Staph. aureus (**The commonest 80%**) → all age groups.
  - Strept. pyogenes, pneumoniae.
  - GBS → newborn.
- **Gm -ve:**
  - E.coli → new born.
  - Salmonella (in sickle cell anemia or after splenectomy).
  - H. influenza (common < 4 years of age).
- **Mixed.**

### Route of Infection

- **Hematogenous:** from septic focus (the commonest).

### Predisposing Factors

- **General**
  - Low immunity.
  - Specific fever in children.
  - Over fatigue in old age.
  - Bad hygiene.
- **Local**
  - Trauma → hematoma formation.
  - Over exertion → epiphyseal strain.
  - Endarteritis → myxomatous degeneration.



Osteomyelitis

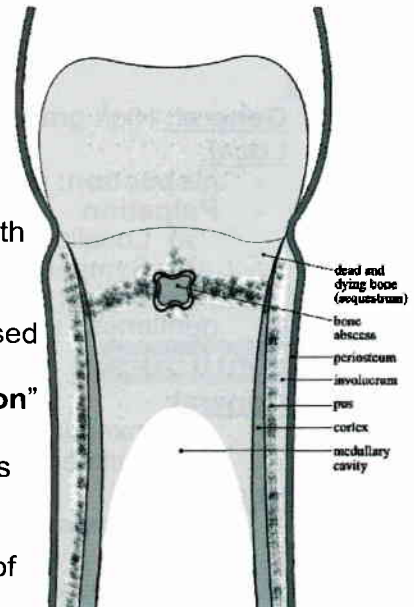
## Pathology

### Site

- **Metaphysis**
  - Most common in the metaphysis of long bone.
  - Commonly upper end of tibia & lower end of femur (around knee).
- **Due to**
  - The metaphysis is supplied by end arteries in children.
  - The metaphysis is the part most liable to trauma.
  - It is the actively growing end of bone.
  - Attachment of the ligaments and muscles to the metaphysis makes it subjected to strain.

## Pathogenesis

- **Trauma** → Metaphyseal hematoma → blood borne infection
- **Suppuration (by the 2<sup>nd</sup> or 3<sup>rd</sup> day):** Pus causes ↑ intra-osseous pressure → Spread of infection
  - Down: in the medullary cavity
  - To the surface: Sub-periosteal abscess. Later the abscess may rupture and may open on the skin with resultant discharging sinuses.
  - To the epiphysis: rare
- **Sequestration:** Separation of periosteum which is raised by pus → cut of blood supply to the outer part of the cortex → necrosis & separation” **Sequestrum formation”**
  - The sequestrum is dead bone. It looks smooth, shiny white, and devoid of periosteum and so gives metallic sound on percussion by a probe.
  - Intramedullary spread may cause cutting of blood supply to inner cortex & the nutrient artery or one of its branches may thrombose → separation of big sequestra
- **New bone formation forms in two sites:**
  - A. **The deep layers of the stripped periosteum** by the end of the 2<sup>nd</sup> week. With time the new bone thickens to form an involucrum enclosing the infected tissues and sequestra. If the infection persists, pus may continue to discharge through perforations (cloaca) in the involucrum and track by sinuses to the skin surface; the condition is now established as chronic osteomyelitis.
  - B. **Around the Haversian canals** resulting in bony sclerosis.



## Fate

- a) **Abortion of the inflammation:** The inflammation can be aborted without suppuration when the appropriate antibiotic is started during the first three days of the illness, and is given in adequate dosage for a sufficient length of time.
- b) **Suppuration:** If treatment is delayed for more than two days a subperiosteal abscess and a variable degree of bone necrosis occur.

## Clinical Picture

### Type of Patient

- Usually ♂ child (may be with history of trauma).
- **History** of septic focus e.g. sore throat – otitis media.

### Symptoms

- **General**
  - Very bad general condition (fever, pallor & sweating)
- **Local**
  - Severe pain (of sudden onset).
  - Swelling.
  - The parents noticed that child fears to use the limb (**Pseudoparalysis**)



Acute Haematogenous Osteomyelitis

### Signs

- **General:** High grade fever – tachycardia.
- **Local:**
  - **Inspection:** redness & edema over the skin.
  - **Palpation**
    - a) Localized tenderness over the bone (**The earliest sign**).
    - b) Sympathetic effusion of the adjacent joint.
  - **Movement:** restricted joint movement (but it can be moved passively with gentleness unlike septic arthritis).

## Complications

- **General:**
  - a) Toxemia.
  - b) Septicemia & pyemia (if immunocompromised).
- **Local:**
  - **Chronic osteomyelitis.**
    - Mild pain & low grade fever (more at night) with loss of weight.
    - Tenderness & thickness of bone with multiple sinuses.
  - Spread: suppurative arthritis (only if metaphysis is intra-capsular e.g. Hip joint).
  - Disturbed bone growth (deformity and/or shortening).
  - Pathological fractures.

## DD

- 1- Ewing's sarcoma.
- 2- Cellulitis (in osteomyelitis, tenderness is elicited along the bone **away** from redness).
- 3- Septic arthritis → **all** movement are **limited** (passive & active).
- 4- Rheumatic arthritis → **fleeting** in character.

## Investigations

- **Laboratory:**
  - 1- CBC: ↑TLC & ↑ESR.
  - 2- Blood culture (at time of fever).
  - 3- The **most certain** is to aspirate pus from metaphysis + C&S.
- **Radiological :**
  1. **U/S** → Subperiosteal abscess + Joint effusion + **U/S guided aspiration**
  2. **MRI** (investigation of choice ) → Contraindicated if metal implant
  3. **CT scan** (when M.R.I. is contraindicated )
  4. **Radioscintigraphy with 99mTc-HDP** (hydroxymethylene diphosphate) → reveals increased activity in the very early stage, but it has relatively low specificity.

**5. X- Ray**

- 1<sup>st</sup> 2 weeks → -ve
- End of 2<sup>nd</sup> wk → faint extra-cortical outline (periosteal new bone formation).
- After 3 weeks (**chronic**) → sequestrum – cloaca – involucrum.
- Exclude Ewing's sarcoma.

**Treatment**

*(Start immediately once suspected)*

**General**

- Hospitalization, bed **rest** & immobilization (until inflammation subsides).

**Medical**

- Analgesic.
- Antipyretics + fluids.
- Antibiotics: **It is the core of treatment.**
  - Delayed for few hours to obtain a valuable blood culture and/or U/S guided aspiration.
  - Early administration of high dose empiric broad-spectrum antibiotics (flucloxacillin, augmentin or vancomycin) + gentamycin for gram -ve organisms then specific antibiotic according to culture and sensitivity.
  - Parenterally for 1-2 wks then Oral for 4-6 weeks (minimum duration 6 weeks)

**Surgical (better)**

- **Indications:**
  1. Obvious collection of pus which must be drained.
  2. If no improvement on antibiotics within 48 hours (from onset of fever) (we have to interfere before chronicity = subperiosteal elevation)
  3. If the patient is first seen after 48 hours.
- **Procedure:**
  - Drainage of subperiosteal abscess + drill holes in the cortex (6-8 holes)
- **Postoperative antibiotics for 6 weeks.**

- **Advantages of surgical Treatment:**

- Draining of pus & culture sensitivity.
- Curettage of septic granulation tissue.
- Washing with saline.
- Local instillation of antibiotics.

**Treatment of complications (Chronic osteomyelitis)**

- Antibiotics & prolonged immobilization.
- Sequestrectomy.
- Saucerization & bone graft.



# Chronic Non-specific Osteomyelitis

## Etiology

### Organism

- Usually mixed infection.
- In the presence of implant the usual organism is staph. epidermidis. .

### Route of Infection

- Follows an open fracture.
- Follows an operation.
- Blood spread

### Predisposing Factors

- Bone cavity surrounded by dense sclerosis.
- Sequestrum, which acts as an irritant and harbours bacteria.
- Bacteria are imposed in the fibrous tissue where they remain dormant, and may be activated at any time.
- Sinuses, which lead to skin surface favouring 2ry infection.

## Pathology

- Cavities containing pus & sequestrum (**dead bone**).
- Multiple sinuses burst through the skin.
- Involucrum (**new bone formation**).
- Cloaca = perforation in the involucrum.
- Pathological fracture.

## Clinical Picture

### Symptoms

- History of acute osteomyelitis.
- Pyrexia.
- Pain at rest (especially at night).
- Discharging sinus.

### Signs

- **General:**
  - Chronic toxemia (mild).
- **Local:**
  - **Inspection:** skin → multiple discharging sinuses discharging pus and sequestra (the commonest presentation).
  - **Palpation:** bone → tender + thickened.

## Complications

- Acute exacerbation.
- Pathological fractures.
- Arrested growth and deformity.
- Toxemia.
- Amyloidosis.(rare)

- ▶ **Etiology:** mixed inf., "direct, blood"
- ▶ **C/P:** as chronic inf. + draining sinuses
- ▶ **Comp.:** as inf. + fractures
- ▶ **Invest.:** as inf. + imaging (X-ray\*)
- ▶ **TTT:** Surgical: Saucerization + Sequestrectomy + Sinusectomy



Chronic Hematogenous Osteomyelitis



Chronic osteomyelitis showing sequestrum of the tibia

## Investigations

### Laboratory

- ↑ ESR & ↑ TLC during flares.
- Culture & sensitivity of discharge from sinus (often misleading), or better from abnormal bone.

### Radiology

- **X-ray:** The most important investigation
  1. Sequestrum.
  2. Involucrum.
  3. Osteoporotic area.
  4. Periosteal thickening & elevation.
- **Radioisotope scan:** It shows hidden foci of infection.
- **CT scan & MRI.**

## Treatment (Surgery is the main line of treatment)

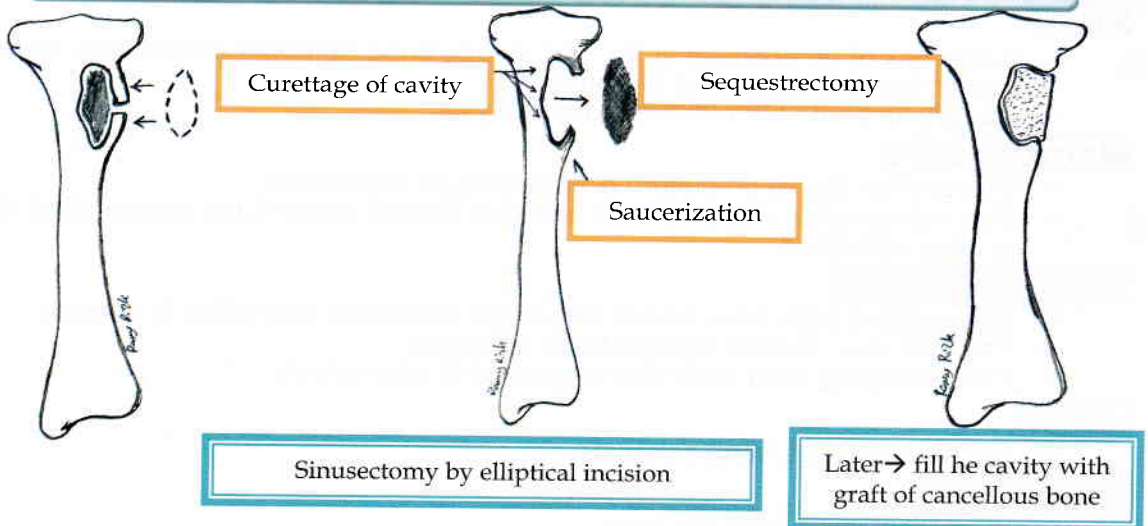
- **Prophylactic** → proper treatment of acute osteomyelitis (see before)
- **Curative :**
  - A. Elderly patients with severe infection and multiple co-morbidities:**  
→ Amputation or prolonged suppressive antibiotic therapy.
  - B. Suitable patients:**  
→ Surgery to arrest infection:

### **Saucerization + Sequestrectomy + Sinusectomy + Bone graft**

#### ○ Postoperative:

- I.V. antibiotics for 4-6 weeks with oral suppression for a further 6 weeks or until union have been achieved.
- Support of the limb to avoid pathological fractures until healthy strong bone regenerates.

Later on, filling the cavity with muscles pedicle or cancellous bone graft.



## Chronic sclerosing osteomyelitis (Garre's type)

### Pathology

- A non-suppurative type of osteomyelitis affecting shafts of long bones.
- There is diffuse thickening of bone with encroachment on the medullary canal. It is not associated either with sequestration or sinus formation.

### Diagnosis

- Pain may be severe.
- X-ray shows marked thickening of the cortex with partial obliteration of the marrow spaces.

### Treatment

- Guttering of the cortex is needed in order to release the tension in the medullary canal.

## Brodie's Abscess

### Definition

- Chronic abscess (chronic osteomyelitis): insidious onset, near the end of long bone.

- ▶ **Etiology:** staph., at end of long bones
- ▶ **C/P:** intermittent pain, effusion
- ▶ **Invest.:** X-ray
- ▶ **TTT:** Saucerization + grafting

### Organism

- Staph. aureus + high resistance of patient.
- Staph. albus + low resistance of patient.

### Pathology

#### Site

- It consists of an abscess at the end of long bone (at upper end of tibia, lower end of femur & upper end of humerus).
- Usually located in the centre of metaphysis.

### Macroscopic

- Pus is often sterile on culture & apple jelly in appearance.
- The wall consists of granulation tissue or fibrous tissue & the surrounding. Bone is often sclerosed.

### Clinical Picture

- **Intermittent pain** near end of long bone especially after effort & at night.
- The joint may contain **sympathetic effusion**.
- The **overlying skin** becomes congested & edematous.

### X-ray

- Abscess cavity & bone sclerosis.

### Treatment

- Excision is very often required.
- Saucerization & grafting by bone chips under antibiotic coverage.

# Acute Pyogenic Arthritis

## Incidence

- Commonest in middle age. (**Liable to trauma**).

## Etiology

## Organism

- Staph., Strept., E-coli., H.influenza and Gonococci (sexually transmitted).

- ▶ **Etiology:** Staph., strept. "direct, blood"
- ▶ **C/P:** as inf. + night / rest pain + complete loss of all movements
- ▶ **Comp.:** Destruction, Dislocation, Disturbed growth, Deformity (ankylosis)
- ▶ **Invest.:** as inf. + imaging "X-ray"
- ▶ **TTT:** AAA + urgent arthorotomy

## Route of Infection

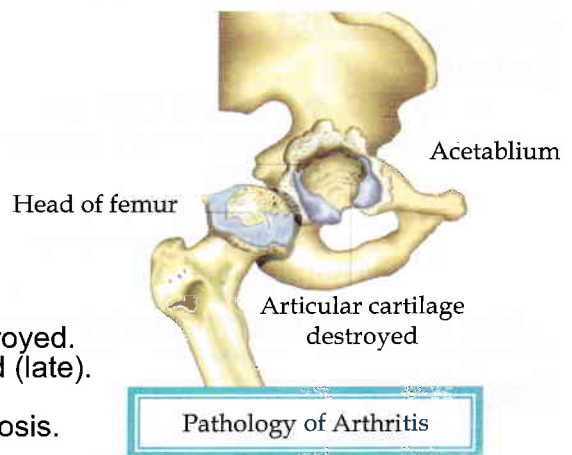
- Hematogenous.**
- Direct through:** Penetrating wound or arthroscopy (iatrogenic).
- Adjacent acute osteomyelitis** (in some conditions → if intra-capsular metaphysis).

## Predisposing Factors

- General:**
  - Septic focus.
  - Low immunity
- Local:**
  - Trauma.
  - Rheumatoid arthritis.

## Pathology

- Pathologic sequence:**
  - Synovitis:** exudates → serous, seropurulent then purulent.
  - Capsule** → stretched then destroyed.
  - Articular cartilage** → destroyed (late).
  - Bone ends** → destroyed (late).
  - Neglected cases** → bony ankylosis.
- Pathological types:**
  - **Serous:**
    - Hot, red, tender, swollen joint.
    - Fluid is clear.
  - **Serofibrinous:**
    - More inflammation, ↑ manifestations.
    - Fluid is turbid.
  - **Purulent:**
    - Pure pus in joint.
    - Throbbing pain, hectic fever.
    - Edema & ulceration of the synovial membrane.
    - Erosion then complete separation of articular cartilage.



## Clinical Picture

## Symptoms

- General:** F A H M.
- Local:**
  - **Pain** (night and rest pain are characteristic): severe, sudden, throbbing (later on).
  - Swelling at the joint area.
  - Inability to move the joint.



## Signs

- **General:** Fever & tachycardia.
- **Local:**
  - **Inspection:**
    - Redness, swelling and discharging sinus (if neglected).
    - Deformity (late)
  - **Palpation:**
    - Hotness and tenderness.
  - **Movement:**
    - **Complete** loss of **all** movements (active & passive).

## Complications

- Bone destruction.
- Pathological dislocation.
- Growth disturbance.
- Bony ankylosis.
- Toxemia, septicemia & pyemia.

## Investigations

### Laboratory

- ↑ TLC. ↑ ESR and CRP +ve.
- **Joint aspiration +/- U/S guidance :**
  - **Diagnostic:**
    - Confirm the diagnosis.
    - Culture & sensitivity.
  - **Therapeutic.**

After aspiration, the joint should be splinted.



## Radiology

- **X-ray:**
  - Early: soft tissue shadow.
  - Later: decreased joint space then complete obliteration bony ankylosis.
- **U/S:** accurate for detection of effusion.

Clinical Picture, X-ray & Treatment of Arthritis

## DD

- Trauma.
- Acute osteomyelitis (passive movement is preserved)
- Rheumatic fever.
- Gout.

## Treatment

### General

- Bed rest + immobilization.
- Antibiotics.
- Analgesics + fluids.
- Antipyretics.

### Specific It is a surgical emergency

- **Washout of the infected joint:**
  - In knee, ankle and shoulder joints → arthroscopic washout or open arthrotomy + washout
  - In hip joint sepsis → only open arthrotomy.
- **If eroded cartilage** → arthrotomy then traction for weeks.
- **If completely separated cartilage** → arthrodesis.

# Tuberculosis of bones

## Pathology

- Tuberculous osteomyelitis is always secondary.

## Common sites

- The commonest site of TB osteomyelitis is the spine.
- This is followed by the ribs, sternum, pelvis, tibia, femur and the short long bones of the hands and feet.

- ▶ **C/P:** children, TB toxemia, pain, swelling
- ▶ **Comp.:** as TB
- ▶ **Invest.:** as TB + X-ray: localized bone destruction with no new bone formation
- ▶ **TTT:** as TB + immobilization (splint), comp.

## Special features of TB of bones

1. Bone destruction and rarefaction predominate over new bone formation.
2. Caseation results in cold abscess and sinus formation.
3. Healing occurs by fibrosis.
4. Sequestration is unusual.
5. Tuberculosis can destroy the epiphyseal cartilage plate and eventually involve the neighbouring joint (unlike pyogenic osteomyelitis).

## Complications

1. Cold abscess formation.
2. Involvement of a joint.
3. Sinus formation.
4. Toxemia.
5. Miliary TB.
6. Amyloidosis.

## Clinical features

1. TB osteomyelitis is usually a disease of **children**.
2. General manifestations of TB in the form of malaise, pallor, weakness, loss of weight and appetite, night fever and sweating.
3. Local manifestations:
  - Pain: It is of insidious onset, aching in nature and more at night.
  - There may be swelling near the joint with marked muscle atrophy.
  - There may be a cold abscess or sinus formation.

## Investigations

1. ESR is elevated, CBC shows anaemia, leucopenia and relative lymphocytosis. Tuberculin test is positive.
2. X-ray. There is **localized bone destruction** with widespread rarefaction with **no new bone formation**.

## Treatment

1. Anti-tuberculous drugs.
2. General management by providing adequate normal diet, ttt of anemia.....
3. Immobilization. Fixation of the limb in position of function in a splint or plaster is performed for up to 6 months where clinical, laboratory and radiological evidence of healing have occurred.
4. Operative treatment. If there is cold abscess or if conservative treatment failed, operative drainage and curettage are to be performed. In certain sites like TB of ribs, resection of the rib may be performed.

### ► Other forms of bone tuberculosis.

1. TB of flat bones (periostitis):
  - The surface of the bone is eroded and abscess forms which often opens on the surface with sinus formation.
2. TB of short long bones (TB dactylitis):
  - The infection starts in the diaphysis. There is central destruction, and the periosteum is raised by TB granulation tissues, with subperiosteal new bone formation. The bone thus becomes fusiform in shape (spina ventosa).

## Tuberculosis of joints

### Pathology

- Joints commonly affected are the hip and knee, but no joint is immune.
- Infection reaches the joint by hematogenous spread from a latent focus from the intestine or the lung or by direct spread from a focus in the adjacent bone.
- The site of initial infection may be synovial which is more common in children and in the knees, or osseous where a bone focus may open into the joint.
- All the joint compartments are affected in the untreated cases.
- The synovial membrane is thickened with multiple tubercles, which may form a caseous mass. A synovial pannus may form resulting in cartilage damage.
- There is marked osteoporosis and bone destruction without new bone formation.
- The surrounding muscles are markedly atrophied.
- Resolution with restoration of complete joint movement never occurs in tuberculous arthritis, which always proceeds to complete joint destruction with any of the following sequelae:
  1. Healing with fibrous ankylosis.
  2. Cold abscess formation.
  3. Pathological dislocation.
  4. Generalized dissemination.
  5. Amyloidosis.

### Clinical features

- ◆ **The patient is usually a child or young adult.**

### Symptoms

1. Pain is the earliest symptom.
2. The child is unwilling to move the joint and muscle spasm keeps the joint fixed in position. During sleep muscle spasm decreases and as soon as the joint moves the child wakes up crying. This is called night starts or cries.
3. General manifestations of TB; night sweating, fever, loss of weight and appetite.

### Signs

1. Swelling results from synovial thickening and rarely effusion.
2. Muscle wasting is characteristic.
3. Joint movements are limited in all directions.
4. The joint becomes stiff and severely deformed.
5. In late cases there may be a cold abscess and sinus formation.

### Investigations

#### A. X-ray

- Shows soft tissues swelling, rarefaction of the bone on both sides of the joint, narrowing of the joint space and blurring of the joint from erosion of subchondral bone.

**B. Laboratory investigations.**

1. CBC shows anaemia, leucopenia and relative lymphocytosis.
2. Tuberculin test is positive.
3. Synovial fluid assessment by aspiration.
4. Synovial membrane or regional LN biopsy may reveal the diagnosis.

**Treatment****A. Early cases:**

- The mainstay in treatment is anti-tuberculous drugs. If started early, the joint may heal and the function be completely restored.
- Local measures include rest, traction and occasionally operation. Splintage should be continued for several months.

**B. Late cases:**

- If the articular surfaces are destroyed, the joint is immobilized until all signs of disease activity have disappeared, then the joint is arthrodesed in the position of maximum function.

## TB of Spine "Pott's Disease"

The spine is the commonest extra-articular TB

**Incidence**

- **Commonest form of skeletal TB.**

- **Age:**

- Children are more affected than adults but no age is immune.

- Peak incidence <5 years (75% below 10 years).

- ▶ **Etiology:** M.tuberculosis, blood, ↓immunity
- ▶ **C/P:** as TB + dull aching back pain, kyphosis, ↓mobility in all directions
- ▶ **Invest.:** as TB + spine imaging
- ▶ **TTT:** medical\*, costotransversectomy or antero-lateral decompression

**Etiology**

- **Organism** → Mycobacterium tuberculosis.
- **Route** → mainly 2<sup>nd</sup> blood born from lung or mediastinal LN.
- **Predisposing factors** → immuno-suppression (skeletal TB is increased in patients with HIV).

**Pathology****Commonest Site**

- **Incidence:** dorsal spine "lower dorsal" > lumbar > cervical.
- More in the dorso-lumbar region because the stress of weight bearing is maximal at this level.
- It affects adjacent parts of the bodies of 2 vertebrae.
- In children the disease starts in the cancellous bone in the centre of the vertebral body.
- In adults the disease starts subperiosteally under the anterior longitudinal ligament.

**Macroscopic**

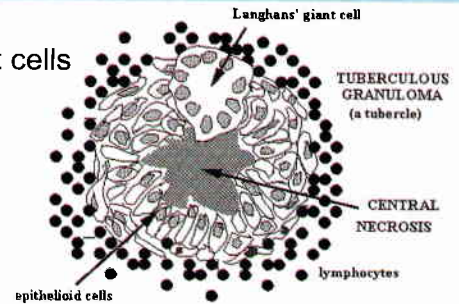
- The vertebral body is destroyed (2 or more adjacent vertebrae) & replaced by caseous material
- Early destruction of the disc.
- Collapse of the vertebrae.

- Collapse of the vertebrae results in:
  - 1-Angular kyphosis.
  - 2-Cold abscess.
  - 3-TB sinus
  - 4-Paraplegia.



## Microscopic

- **Tubercles are formed of** epitheloid cells & giant cells (Langhan's cells) surrounded by lymphocytes & fibroblasts.
- Tubercles fuse together forming larger follicles.
- Depending on the immunity of the patient → caseation or fibrosis.



## Clinical Picture

- **More common in children.**

## Symptoms

- **General:**
  - Manifestations of **TB toxemia** (night fever, night sweat, loss of appetite, loss of weight)
- **Local:**
  - Severe back pain (**dull aching(1)**) more at night (**commonest 1<sup>st</sup> presenting symptom**).
  - insidious onset
  - ↑ At night and on movement.
  - Limitation of movement of the vertebral column.
  - Manifestations of complications.



## Signs

- **General:**
  - Fever + pulmonary TB ± other organ affection by TB.
- **Local:**
  - **Inspection:**
    - Swelling, cold abscess.
    - TB sinus with undermined edge & cyanotic margin (as TB ulcer).
    - Kyphosis(4)
      - Early → correctable (muscle spasm).
      - Late → not correctable.
  - **Palpation:**
    - Tenderness opposite the affected vertebrae.(2)
  - **Movement:**
    - Limitation of movement in all directions (**the most important sign**)(3)
    - Coin test → limited spinal mobility.
  - **Neurological examination:**

Kyphosis, cold abscess(5) and paraplegia(6) are a triad essential for clinical diagnosis.

The yellow numbers = The classical symptoms of tuberculosis of the spine as described by Pott

## Complications

### General

- Spread.
- Secondary amyloidosis → renal failure.

### Local

#### 1- Cold Abscess

- At first, the abscess collects under the anterior longitudinal ligament in front of the vertebral body.
  - It may pass backwards into the spinal canal and may thus press on the cord.



Psoas abscess with cross fluctuation

- It may trickle along various anatomical planes to appear at sites far from the site of the original disease in the spine.
- In cervical region the abscess may appear:
  1. Retropharyngeal (behind the prevertebral fascia).
  2. In the posterior triangle of the neck.
  3. Axilla.
- In thoracic the abscess may extend to:
  - a) Mediastinum.
  - b) Along the intercostal nerves.
    - Paravertebral (posterior branch)
    - Mid-axillary (lateral branch)
    - Parasternal (anterior branch)
- In lower thoracic and lumbar regions the abscess may:
  - It passes into the sheath of the psoas muscle to form the famous psoas abscess which presents as a cystic swelling in the posterior abdominal wall, or it may pass under the inguinal ligament to present in the femoral triangle lateral to femoral vessels with cross fluctuation between the 2 collections.

## 2- T.B. Sinus

- Due to **faulty** drainage of **cold** abscess.

## 3- Pott's paraplegia (10% of cases)

- More with **peri-osteal type**.
- **Usually in upper dorsal spine (the narrowest part).**
  - **Early Reversible** on decompression) due to:
    - Compression of the cord by cold abscess, granulation tissue or by the sequestered disc.
    - Edema of cord.
  - **Late (Irreversible) due to:**
    - Stretching of the spinal cord over an angular kyphosis due to collapse of vertebral bodies.
    - Reactivation of the disease.
    - Ischemia (thrombosis of anterior spinal artery).

## 4- Deformity (angular kyphosis)

- Due to collapse of the vertebral body anteriorly, while the posterior arch is intact.
- More with **osseous type** → Angular kyphosis.
- More marked in **thoracic** region (As cervical and lumbar are normally lordotic)

## Investigations

- **X-ray spine (lateral View)**
  - **Early**
    - 2 or more vertebrae are affected.
    - Rarefaction of the vertebrae (osteoporosis).
    - Decreased joint space.
  - **Late**
    - Destruction of vertebral bodies and amalgamated Inter-vertebral discs.
    - ± Kyphosis.
    - Bone destruction with **NO** new bone formation.
    - Paravertebral abscess shadow.
- **CT-Scan, MRI.** (The most accurate)
- **For pulmonary T.B. :**
  - Blood → leucopenia with relative lymphocytosis, ↑ ESR
  - Chest x-ray → pulmonary lesions.
  - Tuberculin test (good -ve test).
  - Sputum examination, Z.N. stain, culture on Lowenstein Jensen media & PCR.



**T.B of the spine: osteolytic lesion**

## Treatment (Mainly conservative)

### Conservative treatment

- 1- **Anti-tuberculous medications** for 9 months.
- 2- Rest.
- 3- Good nutrition.
- 4- Spine support by plaster cast for short period. When the disease become quiescent this is changed into a spine brace.
- 5- Periodic clinical, haematologic and radiographic assessment.
  - ➔ Under conservative treatment most cases are cured.
  - ➔ Early paraplegia patients respond favourably to this treatment in 60% of cases.
  - ➔ Late Pott's paraplegia is due to increasing severity of kyphosis and responds neither to conservative nor surgical treatment.

### Surgery

#### Indications

- Early Pott's paraplegia with :
  - 1- No sign of recovery after 3-4 weeks of conservative treatment.
  - 2- Paraplegia getting worse in spite of conservative treatment.

#### Aim of surgery

- Decompression of the spinal cord.

#### Technique

- ➔ The caseous material and dead bone are removed by either of two methods :
  - 1- **Costo-transversectomy:** In this operation the posterior ends of one or two ribs and the corresponding transverse processes of the vertebrae are excised and the cold abscess is evacuated.
  - 2- **Antero-lateral decompression:** In this operation ,in addition to costotransversectomy the pedicles and part of the vertebral bodies are excised to achieve decompression.

#### Later treatment

- 1- Life-long follow-up.
- 2- Spine fusion may be needed after clearance of infection, using bone graft.

#### Treatment of complications

##### ➔ Paraplegia :

##### A. Early:

- Anterior decompression and debridement followed by spinal fusion.
- About 80% recover, usually within a few weeks.

##### B. Late:

- If MRI shows a block, operative debridement is still effective even in late cases.
- If there is no block, conservative management of bed-ridden patients.

# Bone Tumors

## Classification

### Benign

- The most common bone tumors.

### Malignant

- Primary
- Secondaries: the most common malignant tumors of bone.

## Primary bone tumors

| Types                           | Benign                           | Malignant                                                     |
|---------------------------------|----------------------------------|---------------------------------------------------------------|
| <b>Bone forming tumors</b>      | Ivory osteoma<br>Osteoid osteoma | Osteosarcoma                                                  |
| <b>Cartilage forming tumors</b> | chondroma<br>Osteochondroma      | Chondrosarcoma                                                |
| <b>Fat forming tumors</b>       |                                  | Liposarcoma                                                   |
| <b>Fibrous tumors</b>           | Fibroma<br>Fibrous dysplasia     | Fibrosarcoma                                                  |
| <b>Vascular tumors</b>          | Hemangioma                       | angiosarcoma                                                  |
| <b>Uncertain</b>                | Giant cell tumor                 | Malignant giant cell tumor                                    |
| <b>Marrow tumors</b>            |                                  | Ewing's sarcoma<br>Multiple myeloma<br>Reticulum cell sarcoma |

## i- Benign Bone Tumors

### Osteoma

#### A. Ivory (compact) osteoma

### Incidence

- Rare.

### Site

- Membranous bones (especially the skull and Mandible)

### Clinical Picture

- According to site e.g:
  - **Inner table** → ↑ ICT.(focal epilepsy)
  - **Outer table** → cosmetic(alopecia)
  - **Orbital cavity** → proptosis.
  - **Auditory meatus** → deafness

### Investigation

- **X ray**: dense bone swelling with a well-circumscribed edge.



Osteoma in Orbital cavity



### Treatment

- The tumor never turns malignant .
- **Excision** if causing pre symptoms by Gigli saw or electric saw (to avoid concussion by chiseling).

## B. Osteochondroma (exostosis)

### Incidence

- **Common** (35% of benign bone tumors)
- **Age:** adult.
- **Sex:** male.

- ▶ **Path.:** metaphysis, away from joints, bony stalk
- ▶ **C/P:** painless lump, comp., association
- ▶ **Comp.:** Pathological fracture, Pressure, Bursitis, Bad cancer (malignancy)
- ▶ **Invest.:** X-ray
- ▶ **TTT:** - Single: excision  
- Multiple: removal of complicated one

### Pathology

- **Metaphysis** of long bones
- (distal femur, proximal tibia and proximal humerus) never affect flat bones.
- Grows **away** from joints.
- Formed of **bony stalk + cap of cartilage** + bursa above it.
- The tumor continues to grow till the time of closure of epiphyseal cartilage, any further growth is suggestive of malignant transformation.

### Types

- It may be **single** (hamartoma) or **multiple** (may be associated with **Gardner's syndrome** (Sebaceous cyst, Desmoid tumor, FPC & exostosis) → precancerous → **chondrosarcoma**).

Metaphyseal aclasis " hereditary multiple exostosis" is the most common of all dysplasias

### Presentations

- Painless lump.
- Present with **one** of complications e.g.: pain, malignant transformation.
- May be associated with Gardner's syndrome (see GIT) or dwarfism.

### Complications

- Bursitis.
- Pathological fracture.
- Pressure on neurovascular tissue.
- Malignant transformation → chondrosarcoma (rapid growth, painful, invasion, metastasis).

### Investigations

- **X-ray:** well defined exostosis emerging from metaphysis (looks smaller because cartilaginous cap doesn't appear in X-ray).

### Treatment

- **If single** → excision including the cartilage cap but, don't remove it in a child till epiphyseal plate closure.
- **If multiple** → removal of complicated one.



## C. Osteoid Osteoma

### Incidence

- **Common** (15% of benign bone tumors)
- **Age:** <30 years.
- **Sex:** male.
- **Origin:** bone cortex.

### Pathology

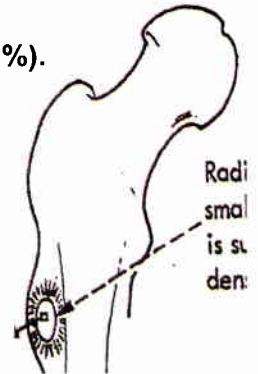
- It is formed of a nidus(<1cm in cortex of femur or tibia) of immature osteoid tissue surrounded by bone sclerosis

### Clinical Picture

- **Painful small nodule in diaphysis of femur (38%) or tibia(19%).**
- Pain increases at night and relieved by aspirin .

### Investigations

- **X-Ray:**
  - Central radiolucent area surrounded by dense sclerosis.
  - If >2cm → named **osteoblastoma**.
- Bone scan: shows marked activity(hot spot)



### Treatment

- Excision + salicylates for pain.

## D. Chondroma

- **Ecchondroma** (periosteal or juxtacortical chondroma) → (grow outwards).
- **Enchondroma** → (grow inwards).

### Definition

- It is a benign cartilaginous tumor formed of lobular mass of hyaline cartilage.

### Cell of origin

→ Chondroblast

### Types

1. Ecchondroma.
2. Enchondroma .

### Pathology

- **Number:** usually solitary, but in enchondroma multiple enchondromatosis may be present → Ollier's disease (non hereditary).
- **Site:**
  - Ecchondroma → long tubular bones (usually metaphysis).
  - Enchondroma → - Short bone (hand & feet)    - Flat bones (ribs & scapula)
  - Ends of long bones
- **Macroscopic picture:** a white, soft & multilobulated mass having a fibrous pseudocapsule
- **Microscopic picture:** 1. Chondrocytes.                      2. Cartilaginous matrix.
- **Malignant transformation:** Enchondroma turn malignant **except**  
Enchondroma of short bone of hand & foot in children.

- ▶ **C/P:** - Ecchondroma: local pain & swelling
- Enchondroma: asymptomatic
- ▶ **Invest.:** X-ray, CT, MRI
- ▶ **TTT:** - Ecchondroma: wide excision without rupture of capsule
- Enchondroma: chiseling

### Clinical picture

- **Ecchondroma** → symptomatic (local pain & swelling).
- **Enchondroma** → usually asymptomatic (if , just a swelling)

### Investigations

- **X-ray:**
  - Ecchondroma → soft tissue mass eroding the cortex  
calcification is common
  - Enchondroma → well defined lesions with some calcification & may show cortical expansion.
- **CT & MRI:** for intracranial or spinal lesions.



### Treatment

- Ecchondroma → mostly needs wide excision including the underlying cortex without rupture tumor capsule.
- Enchondroma → Chiseling

## ii- Malignant Bone Tumors

### A. Bone Seconadries (50%)

#### Incidence

- **50%** of malignant tumors of bone (most common).
- Age: usually above **50** years.

- ▶ **Etiology:** cancer breast, prostate (2/3 cases) systemic, direct spread
- ▶ **C/P:** as cancer + fractures,  $\uparrow\text{Ca}^{++}$ ,  $\downarrow$ mobility
- ▶ **Invest.:** for 1ry, enzymes, radiology
- ▶ **TTT:** palliative

#### Source

- 2/3 cases: → from cancer breast or prostate.
- 1/6 cases: → from other cancers e.g.: thyroid, lung, kidney or GIT
- 10% of cases: → occult 1ry.

#### Route of spread

- Systemic circulation: from tissues which drain into the vena cava → heart → lung → penetrate the capillaries → systemic circulation.
- Direct connection between pelvic venous plexus and vertebral vein.
- Direct invasion as tumors of rectum in pelvic bones.

- Metastases in cancer prostate are either direct to the pelvic bones or due to reversal of blood flow from prostatic plexus (veins of Santorini) to the axial skeleton through valveless veins of Batson.
- Metastases in cancer breast are either direct to ribs or via intercostal veins which communicates with paravertebral veins via Azygous vein.

#### Pathology

- Usually osteoclastic, rarely osteoblastic especially in cancer prostate.
- **Site:**
  - Where **red marrow** is plentiful e.g.
    - Trunk bones (vertebrae 15%, skull, pelvis 25%, ribs).
    - Root bones (upper end femur & humerus) 45%.
- **Macroscopic & Microscopic:**
  - Correspond to that of the 1ry.

## Clinical Picture

### Symptoms

- **General:**
  - Symptoms of primary tumor (painless breast lump, prostatism...etc).
  - Symptoms of secondaries to other sites. e.g. hemoptysis.
- **Local:**
  - Bone aches (pain): is the commonest and often the only clinical feature.
  - Swelling.
  - Disturbance of function:
    - Pathological fractures.
    - Manifestations of hypercalcemia:
      - G.I.T.: nausea, vomiting & constipation.
      - C.N.S.: confusion & fatigue.
      - Others: polyuria (nephrogenic D.I.), renal stones...etc.

### Signs

- **General:**
  - Cachexia, signs of the primary tumor. e.g. breast mass with Peau d'orange appearance in cancer breast.
- **Local:**
  - Inspection:
    - Redness & swelling.
  - Palpation:
    - Hotness & tenderness.
  - Movement:
    - Limited mobility due to pain.

## Investigations

### For the primary tumor

- **E.g. breast carcinoma:**
  - Imaging:
    - Mammography. - U/S.
  - Pathology.
    - FNABC. -  $\pm$  Corecut biopsy.

### Enzymes

- **Acid Phosphatase:**  $\uparrow$  with cancer prostate.
- **Alkaline Phosphatase:**  $\rightarrow \uparrow$  with bone destruction.

### Radiology

(Always multiple, If solitary  $\rightarrow$  the primary origin may be R.C.C. or Thyroid carcinoma), but bone sarcoma must be excluded,.

- **Bone scan  $Tc^{99}$ :** very early diagnosis may reveal unknown secondries as "hot spots".
- **Plain x-ray:**
  - Osteolytic  $\rightarrow$  more common in area of destruction with no new bone formation
  - Osteogenic  $\rightarrow$  prostatic cancer.

## Treatment

- ➔ **The treatment is palliative:**
  1. Painful deposits are treated by radiotherapy.
  2. Pathological fractures are treated by a combination of internal fixation and radiotherapy.
  3. Chemotherapy.



## B. Malignant Primary Bone Tumors

- Osteoclastoma = giant cell tumor.
- Osteosarcoma.
- Ewing's tumor.
- Chondrosarcoma.
- Fibrosarcoma.

### Scheme for Malignant Tumors

#### Incidence

- Percentage of occurrence.
- Age.
- Sex.

#### Pathology

- Site.
- Cell of origin.
- Macroscopic
- Microscopic.
- Spread

#### Clinical Picture

#### DD

#### Investigations

- For diagnosis:
  - X-ray, CT scan, MRI.
  - Biopsy.
- For staging.
- For preoperative preparation.

#### Treatment

- Surgical → excision or amputation
- Radiotherapy or chemotherapy.

### Staging of Malignant Bone Tumors

#### (TNM system)

- ➔ This system is applied to all primary bone tumors except multiple myeloma, juxtacortical chondrosarcoma and paraosteal osteosarcoma.

|      |                                    |
|------|------------------------------------|
| • Tx | Primary tumor can not be assessed. |
| • T0 | No evidence of primary tumor.      |
| • T1 | Tumor confined within the cortex.  |
| • T2 | Tumor invades beyond the cortex.   |
| • Nx | Regional LNs can not be assessed.  |
| • N1 | No regional LNs metastases.        |
| • N1 | Regional LNs metastases.           |
| • M0 | No distant spread.                 |
| • M1 | Evidence of distant metastases.    |

# I- Giant Cell Tumor (Osteoclastoma)

## Incidence

- Giant cell tumor accounts for **5-9%** of all primary bony tumors.
- **Age:** 20 - 40 years (**third decade**).
- **Sex:** female > male

- ▶ **Path.:** epiphysis, long bones, locally malignant, eccentric
- ▶ **C/P:** as tumor + fractures, globular swelling with egg-shell crackling sensation
- ▶ **Invest.:** as tumor + X-ray
- ▶ **TTT:** curettage or excision + reconstruction

## Pathology

### Site

- **Epiphysis** of long bones.
- **Around knee** and **away** from **elbow** (most often the **distal femur** & **proximal tibia** 50%, distal radius 12%, and proximal humerus 6%).

### Cell of origin

- Unknown (thought to be osteoclasts hence the old name osteoclastoma).
- Osteolytic.
- It occurs only in mature bone.

### Macroscopic

- It characteristically extends up to the subarticular bone but usually does not invade the articular cartilage.
- The tumor has a reddish brown, fleshy appearance; it comes away in pieces quite easily when curetted, but is difficult to remove completely from the surrounding bone.



Giant cell tumor

### Microscopic

- Multinucleated giant cells.
- Spindle shaped or ovoid stromal cells, which may be responsible for determining the aggressiveness of the tumor.
- all giant cell tumor are considered potentially malignant.
- Blood vessels → large thin walled.
- Little collagen.

### Spread

- **Locally malignant (aggressive)**
  - Starts **eccentric**, expands bone around it.
  - The affected bone cortex is thin like eggshell, liable to fractures.
  - The tumor is separated from medullary cavity by medullary plug.

- Giant cell tumor of bone is a benign lesion that is a usually solitary and locally aggressive.
- It is believed by some to be potentially malignant.
- In the very rare instances this lesion has the potential for metastasis to the lungs (<10%).

## Clinical Picture

### Symptoms

- **Local:**
  - **Pain (at the end of a long bone):** slowly progressive (**late**), it arises when the lesion begins to destroy the cortex and irritate the periosteum or when the weakening of the bone caused by the tumor causes pain due to imminent pathologic fracture.

- Swelling.
- History of trauma and pathological fractures in 10-15% of cases: (early).

- **General:** rarely manifestations of metastasis.

## Signs

- **Local:**

- **Bony swelling** at the end of a long bone

- **Inspection:**

- Globular.
- Skin → stretched.
- The neighboring joint is often irritated.

- **Palpation:**

- Sharply defined edges.
- The consistency depends on the degree of thinning of the cortex , it may be soft, firm or egg-shell crackling sensation.
- No palpable LNs.

- **General:** rarely manifestations of metastasis.



C/P of Giant cell tumor

## Complications

- **Spread:**

- Local: spread and pathological fracture.
- Systemic: rarely lung metastasis (blood).

## Investigations

### For diagnosis

- **Radiology**

- **X-Ray:**

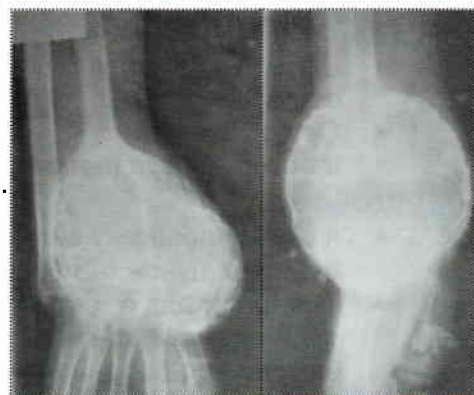
- Eccentrically placed. The center is the most radiolucent.
- Soap bubble appearance.
- Thin expanded cortex.
- Medullary plug.
- Absence of this plug may signify malignant osteoclastoma or bone metastases.

- CT, MRI.

- **Lab:** ↑ ESR.

- **Biopsy:**

- percutaneous needle or Tru-cut techniques.
- Limited open biopsy.



X-ray Giant cell tumor

### For staging

- CXR, some authors recommend a chest CT scan for all patients newly diagnosed.

### For preoperative preparation

- Organ profile.

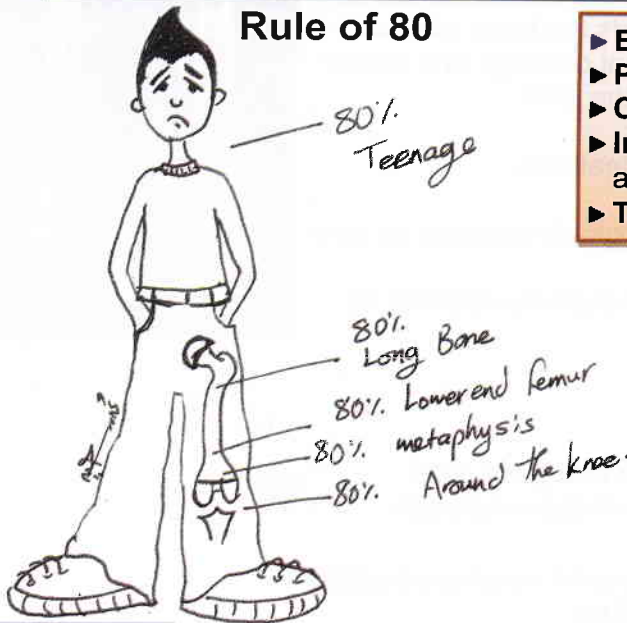
## Treatment

- **Important bone:** e.g. femur:
  - Curettage + bone graft.(50% recurrence)
  - Excision + reconstruction (prothesis or osteocartilagenous grafts).
- **Unimportant bone:**
  - e.g. fibula → excision with safety margin.
- **Inaccessible bone:** e.g. pelvis → radiotherapy.

- If recurrent tumors with suspicious of malignancy → amputation.

## II- Osteosarcoma

### Rule of 80



- ▶ **Etiology:** Paget's dis., irradiation
- ▶ **Path.:** metaphysis, osteoblasts
- ▶ **C/P:** early pain, swelling, fractures, L.Ns
- ▶ **Invest.:** as cancer + X-ray (sun ray appearance, Codman's triangle), biopsy
- ▶ **TTT:** amputation or wide local excision

### Incidence

- Most common primary malignant bone tumor (in children).
- It is the 8<sup>th</sup> malignant tumor of pediatrics.
- About 20% of all 1ry boen tumors are osteosarcoma.
- It is a highly malignant tumor.

### Age

- 10-25 Years (2<sup>nd</sup> decade).
- 80% in teenage.

### Sex

- Males > Females.

### Predisposing Factors

- Paget's disease of bones (in elderly >40Yrs).
- Extensive Irradiation.
- Fibrous dysplasia.
- Diaphyseal aclasis (very rare).

### Paget's disease of bones (Osteitis deformans)

- ▶ Starts by Osteoclastic resorption Then osteoblastic regeneration of a primitive coarse-fibred bone (bone cirrhosis).
- ▶ **C/P:** mostly accidentally discovered ....thickened bones and it may be painful.
- ▶ **TTT:** calcitonin

### Pathology

#### Site

- **Metaphysis** of long bone (rule of 80).

#### Cell of Origin

- **Osteoblasts** → osteogenic.



### Macroscopic picture

- Osteosarcoma destroys and replaces the normal bone.
- The tumor rapidly infiltrates towards the bone marrow early, but it respects the epiphyseal cartilage and hence does not invade the epiphysis or the joint.
- It may be osteogenic or osteolytic.
- There are four main pathological features:
  1. Bone destruction.
  2. Tumor bone formation (radiologically appears as sun-ray appearance).
  3. Reactive bone formation (radiologically appears as codman's triangle).
  4. Soft tissues infiltration.



### Microscopic picture

- Malignant osteoblasts.
- May be → cartilage, fibrous tissue and giant cells.
- Blood vessels → thin wall - hemorrhage – necrosis.

### Spread

- **Direct** (course) starts central & respect epiphyseal plate:
  - **Invades** medullary cavity (**no plug**).
  - **Penetrates** cortex (**no expansion**) → phantom bone.
  - **Raise** periosteum.
  - Perforate periosteum → soft tissue infiltration.
- **Blood:** → BLBL (80% lung metastasis).
- **Lymphatic** → Rare & late.

*In osteosarcoma: osteosclerotic lesion has better prognosis than osteolytic.*

### Clinical Picture

#### Symptoms

- **General:**
  - Anemia, cachexia, fever, malaise, lethargy.
  - Metastasis (e.g.: cough, hemoptysis...).
- **Local:**
  - Pain is **early**. It is constant, worse at night and gradually increases in severity.
  - Swelling.
  - Pathological fracture is **uncommon** because the patient is bed ridden due to pain).



Appearance of Osteosarcoma

#### Signs

- **General:** fever, cachexia.
- **Local:**
  - **Inspection:**
    - Swelling.
    - Overlying skin: dilated veins.
  - **Palpation:**
    - Bone swelling which is:
      - Warm, tender, identified.
      - Firm to hard with soft areas.
      - Local tenderness.
    - LNs: affected late.

## Differential diagnosis

1. Chronic non-specific osteomyelitis.
2. Giant cell tumor.
3. Other malignant bone tumors as chondrosarcoma, fibrosarcoma, Ewing's sarcoma and reticulum cell sarcoma.
4. Secondary carcinomatous deposits.

## Investigations

### For Diagnosis

- **Radiology:** No single feature is diagnostic
  - **X-Ray:**
    - Ill-defined destructive lesion:
      - Start in metaphysis.
      - Destroys the cortex.
      - Invades the soft tissue.
    - New bone formation:
      - **Sun ray appearance** (stretched blood vessels around which new bone formed).
      - **Codman's Δ.** ( Reactive at the angle between the periosteum and the shaft called a Codman's triangle).



Neither sun ray nor codman's triangle is pathognomonic of osteosarcoma.

- Soft tissue mass around the bone.
  - CT, MRI.
- **Lab:** ↑ESR.
- **Biopsy:**
  - Percutaneous, Tru-cut biopsy or open biopsy.

### For staging

- E.g.: CXR, U/S.

### For preoperative preparations

- Organ profile.



## Treatment

1. **Local control of the disease:** is by either
  - a- Amputation: The level of amputation should be proximal to the joint above the tumor, e.g., osteosarcoma of the tibia is treated by above knee amputation.

or

  - b- Wide local excision and prosthetic replacement.
2. **Adjuvant chemotherapy** has markedly improved the prognosis.

## III- Ewing's sarcoma

### Incidence

- The **second** most common primary malignancy of bone in **pediatric** age.
- **Age:** 10-20 years.
- **Sex:** male > female.

- ▶ **Path.:** diaphysis, round cell
- ▶ **C/P:** as osteosarcoma + FAHM
- ▶ **Invest.:** as cancer + X-ray (onion peel), biopsy
- ▶ **TTT:** chemo & radiotherapy, surgical

### Pathology

#### Site

- **Diaphysis** of long bones and gives rise to periosteal reaction.
- Also flat bones as scapula and pelvis.

#### Cell of origin

- **Round cell** (BM reticulocytes).

#### Macroscopic picture

- Soft grayish brain like tissue + areas of hemorrhage and necrosis.

#### Microscopic picture

- Round cells forming rosettes around blood vessels → rosette-shape appearance.
- Intracellular glycogen. (the presence of glycogen differentiates it from reticulum cell carcinoma and secondary from neuroblastoma)
- **No** matrix.

#### Spread

- Direct.
- Blood: BLBL (**common**).
- Lymphatic: **common**.

### Clinical Picture

#### Symptoms

(As osteosarcoma + constitutional symptoms (FAHM) → DD: acute osteomyelitis)

- **General:**
  - Anemia.
  - Cachexia.
  - Lethargy.
  - Fever (intermittent or continuous).
  - Malaise.
  - Metastasis: e.g. hemoptysis.
- **Local:**
  - Pain (early)
  - Pathological fractures are uncommon because patient is bed ridden due to pain.
  - Swelling.

#### Signs

- **General:** fever, anemia, cachexia..etc.
- **Local:**
  - **Inspection:**
    - Swelling.
    - Overlying skin congested
  - **palpation:**
    - Swelling: warm, tender & ill-defined.
    - LN: commonly palpable.



Ewing's sarcoma

## Investigations

### For diagnosis

- **Radiological:**
  - X-ray:
    - **Onion Peel Appearance** (osteolytic + periosteal new bone formation).
    - More often the tumor extends into surrounding soft tissues and may show sun-ray appearance and Codman's triangle
  - CT & MRI.
  - Bone scan.
- **Laboratory**
  - ↑ ESR.
  - leucocytosis
- **Biopsy:** Tru-cut biopsy or open biopsy.



### For staging CXR, U/S.

### For preoperative preparation Organ profile

## Differential Diagnosis

- a. Acute osteomyelitis: biopsy
- b. Secondaries from neuroblastoma :
  - Child < 4 years
  - Catecholamines increased in urine.
  - No intracellular glycogen.
- c. Reticulum cell sarcoma
  - Presence of reticulin fibers.
  - No intracellular glycogen.

## Treatment

- **Combination of :**
  1. Chemotherapy.
  2. Irradiation.
  3. Surgery:
    - Amputation (rarely needed).
    - Then, a further course of chemotherapy is continued for 1 year.
    - Recently: excision & prosthetic replacement is better than amputation.

## Prognosis

Poor 5 years survival is 5-10%.



|                         | Osteoclastoma                                                                           | Osteosarcoma                                                                                                                                                                                                                                                                         | Ewing's                                                              |
|-------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <b>Age &amp; Sex</b>    | -15 - 45 years.<br>-F > M                                                               | -10-25 years.<br>-M > F<br>-Most common 1ry malignant tumor.                                                                                                                                                                                                                         | -5 - 15 years.<br>-M > F                                             |
| <b>Site</b>             | -Epiphysis of long bones.<br>-Around knee and away from elbow.                          | -Metaphysis of long bone.<br>-(Rule of 80).                                                                                                                                                                                                                                          | -Diaphysis & metaphysis of long bones.                               |
| <b>Cell of origin</b>   | - Unknown (thought to be osteoclasts hence the old name osteoclastoma)<br>- Osteolytic. | -Osteoblasts → osteogenic.                                                                                                                                                                                                                                                           | -Round cell (BM reticulocytes).                                      |
| <b>Spread</b>           | -Locally malignant (aggressive).                                                        | -Direct .<br>-Blood → BLBL<br>-(80%lung metastasis).<br>-Lymphatic→ Rare & Late.                                                                                                                                                                                                     | 1. <b>Direct</b><br>2. Blood→BLBL(common).<br>3. Lymphatic→ common.  |
| <b>Clinical Picture</b> |                                                                                         |                                                                                                                                                                                                                                                                                      |                                                                      |
| <b>Signs</b>            | Bony swelling which is:                                                                 |                                                                                                                                                                                                                                                                                      |                                                                      |
| <b>Swelling</b>         | - Globular<br>- Sharply defined<br>-Egg shell crackling sensation.                      | - Warm, tender, identified<br>- Firm to hard with soft areas.                                                                                                                                                                                                                        | - Warm, tender, ill defined.                                         |
| <b>LN</b>               | -No LNs.                                                                                | -Late affected.                                                                                                                                                                                                                                                                      | -Common.                                                             |
| <b>X-ray</b>            | - Soap bubble appearance.<br>- Thin expanded cortex.<br>- Medullary plug.               | <u>Ill defined destructive lesion:</u><br>- Start in metaphysis<br>- Destroys the cortex<br>- Invades the soft tissue<br><u>New bone formation:</u><br>- Sun ray appearance (stretched BVs around which new bone formed)<br>- Codman's Δ<br><u>Soft tissue mass around the bone.</u> | -Onion peel appearance (Osteolytic + periosteal new bone formation). |

## IV- Chondrosarcoma

### Definition

- Malignant tumor characterized by formation of cartilage.
- This tumor **commonly** occurs in the **pelvis**, **ribs** or **proximal** long bones in **middle-aged** people.

### Incidence

- Age: 30-60 years
- Sex: males > females

### Types

- 1- Primary chondrosarcoma:
  - It affects any bone developed from cartilage, especially femur, pelvis.
- 2- Secondary chondrosarcoma:
  - a. It occurs on a top of osteochondroma.
  - b. Malignant transformation is suspected by:
    - Enlargement after closure of epiphyseal cartilage.
    - Rapid increase in size.
    - Pain.
    - Invasion of the mother bone.

### Investigation

- X-ray: fluffy calcification (rings & arcs)

**It metastasizes late to the lung**

### Treatment

- The tumor is resistant to radiotherapy and chemotherapy.
- Surgery is the only line of treatment.



## V- Fibrosarcoma of bone

### Pathology

- Fibrosarcoma is rare in bone and is more likely to arise in previously abnormal tissue ( a bone infarct, fibrous dysplasia or after irradiation)
- The tumor is slowly growing.
- Histologically, it consists of mass of fibroblastic tissue with scattered atypia and mitotic cells.

### Clinical Picture

- It occurs in older age than osteosarcoma (20-60 years)
- Pain (less severe than that of osteosarcoma), Swelling ± pathological fracture.
- Invasion of the mother bone.

### Investigation

- X-ray: shows indistinct area of bone damage.

### Treatment

- Low grade, well-confined tumors : can be treated by wide excision with local prosthetic replacement.
- High grade tumors: require radical excision or amputation. If this can't be achieved, local excision must be combined with radiation therapy.

## Bone cysts

### A. Aneurysmal bone cyst

#### Incidence

- **Patient** → < 30 years. Females > males
- A relatively rare type of bone cyst

#### Pathology

- **Site** → **Metaphysic** of long bones and spine
- **Naked eye** → loculi filled with blood separated by septa.

#### Clinical Picture

- Pain: dull.
- Tenderness.
- Swelling: mild **eccentric**, may become huge.
- Recurrence.

#### Investigation

- **X-ray**: Eccentric cyst, coarse trabeculae.

#### Treatment

- Curettage & grafting.



X- Ray Aneurismal bone cyst

### B. Simple bone cyst

#### Pathology

- **Site** → metaphysic of **upper humerus** or femur.  
(The most common type of bone cyst)
- **Patient** → child – adolescent (1<sup>st</sup> and 2<sup>nd</sup> decades of life).
- **Gross** → cyst:
  - Unilocular or multilocular.
  - Filled with clear straw colored fluid.
  - Lined by a CT membrane with few osteoclasts.

#### Clinical Picture

- **Asymptomatic** → discovered accidentally.
- Pain.
- Local thickening of bone (swelling).
- Pathological fracture ">50% of presentations" (disturbance of function).

**Investigation**

- **X-ray:**
  - Oval – **central** – translucent.
  - Thin cortex.

**Treatment**

- Curettage & graft.
- Aspiration of the cyst cavity and injection with corticosteroids.
- Treatment of pathological fractures.



# Deformities

**Causes of deformity****Causes at a Joint**

- a- Congenital dislocation e.g. C.D.H.
- b- Congenital contracture of a ligament e.g.; T.E.V.
- c- Traumatic:
  - i. Unreduced dislocation.
  - ii. Soft tissue trauma → burns & ulcers.
  - iii. Bone or epiphyseal trauma.
  - iv. Infarction of muscles e.g. Volkmann's ischemic contracture.
- d- Muscle imbalance.
- e- Joint destruction e.g. Arthritis.

**Causes in a Bone**

- a- Congenital e.g.: congenital coxa vara.
- b- Fractures: malunited fracture.
- c- Bending of soft bone e.g. rickets.
- d- Unequal growth of bones either retarded as in epiphyseal injuries or accelerated as in osteomyelitis.



# A. Foot Deformity

## I- Congenital Talipes Equino Varus "Club Foot"

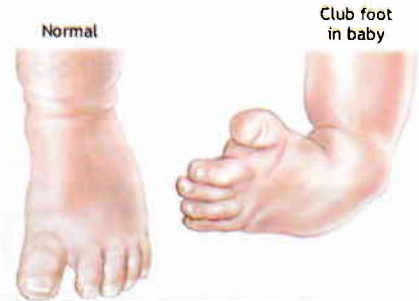
- Tali = Talus = Ankle
  - Pes = Foot.
- } in Latin

### Incidence

- 1:1000
- Girls > Boys.
- Bilateral > unilateral.

### Etiology

- **Idiopathic 95%.**
  - 1- Imbalance between invertor planter flexors & evertor dorsi flexors.
  - 2- Mal-insertion of the tendons.
- **Other causes** → Prolonged malposition of fetus in utero.



Congenital Talipes Equino Varus

### Pathology

#### 1- Deformity:

- o Planter flexion of the foot at the ankle.
- o Inversion of the foot.
- o Adduction of the forefoot

#### 2- Shortening of all ligaments on the medial side of the foot.

### Diagnosis

- **Presence of the specific deformity (triad) at birth which can't be corrected passively & consists of:**
  - **Inversion** of the foot → subtalar joint.
  - **Adduction** of forefoot → tarso metatarsal joint.
  - **Equines** (planter flexion) → ankle joint.
- **Complete neurological examination must be done to exclude paralytic & spastic types of deformity.**

### Investigation

- **X-ray:**
  - **A/P View**
    - Talo-calcaneal angle is ↓.
    - A line projecting the long axis of talus forward passes laterally.
  - **Lateral View**
    - Tibio-calcaneal angle is obtuse.



Cast for maintenance of the correction

### Treatment

#### Conservative

- **Correction** of the deformity:
  - Starting from distal to proximal (begin in the 1st wk. of life).
- **Maintenance** of the correction by:
  - Adhesive strapping (in the 1st 2-3 wks).
  - Plaster of Paris.



- To avoid recurrence of deformity use of a Denis Browne splint at night time is recommended until age 2 years. Splinting is not required during day time.

## Operative Treatment

- **Indications:** (3R) Resistant, Residual, Relapsing deformity:
  - < 2ys "**soft tissue deformity**" → posteromedial release.
  - 2-10ys "**bonny deformity also**" → bone reshaping.
  - >10ys → triple Arthrodesis.

**Posterior release** = ETA + posterior capsulotomy of ankle.

**Medial release** = deltoid & spring lig. are cut. & the tendon of tibialis posterior is lengthened.

**Tendon transfer:** half of tibialis posterior tendon is transferred to the lateral side of the foot.

### Bony operations:

- Varus heel → wedged osteotomy of calcaneus
- Varus foot → removal of a lateral wedge at calcaneo-cuboid joint
- Triple arthrodesis = arthrodesis of subtalar, talo-navicular & calcaneo-cuboid joint.

## Guidelines for treatment of Congenital Talipes Equino Varus

|                      |                        |
|----------------------|------------------------|
| 0 – 1 month age      | Manipulation by mother |
| 1 month – 1 year age | Serial corrective cast |
| 1 – 3 years          | Soft tissue release    |
| > 10 years           | Triple arthrodesis     |

## II- Pes planus (flat foot)

### Type

- **Congenital:** vertical talus.
- **Infantile:** with start of walking.
- **Acquired** (lax ligament & ms. - obese - genu valgum – cruch - fractures- muscle paralysis or spasm).

## III- Pes cavus

### Cause

- **Idiopathic** (common).
- **Paralysis** of muscles.

**Treatment:** Operative release (soft tissue – wedge tarsotomy)



## IV- Hammer toe

- **Flexion** at inter-phalangeal joint.

## V- Hallux valgus

- **Treatment** → excise base of proximal phalanx See general.



## B. Knee deformity

### I- Genu Valgum

#### Causes

- **Soft bones:** rickets.
- **Postural** : at 10 years.
- **Malunion** of fractures (femur , tibia).

#### Clinical Picture

- Knock knee → disappears on knee flexion.

#### Treatment

- Treatment of rickets.
- >3 years → osteotomy osteoclasia.
- Adult → osteotomy. ( McEwen's osteotomy)



### II- Genu varum

#### Cause

- As valgum.



### III- Tibia vara

#### Clinical Picture

- Bow legs.

#### Treatment

- Of cause (rickets).
- As G.Valgum.

### IV- Flexion deformity

- E.g. Scar or muscle paralysis on the back of knee.

### V- Genu Recurvatum (hyperextended knee)

#### Cause

- **Congenital:** short quadriceps (treatment → elongate it).
- **Acquired** e.g.: poliomyelitis (treatment → support).



#### → The Natural History.

- A newborn initially presents with bow legs. With normal growth, knees gradually become straight by the age 18 months.
- With further normal development knees gradually shift into valgus (knock knee). This knock knee deformity is maximum at around age 3-4 years.
- By the age 7 years knee return to normal

## SLIPPED UPPER FEMORAL EPIPHYSES

- **Age:** 10 - 18 years
- **Sex:** boys > girls.
- 25% are bilateral
- Patients are usually overweight and may have Frohlich's syndrome.
- The femoral head is displaced downwards and backwards.

### Complication

- Coxa vara.

### Clinical picture

- Pain and Limp.
- External rotation of the leg.

### Investigations

- **X-ray**
  - Normally in AP a line drawn along the superior aspect of the femoral neck passes through
  - A small part of the femoral epiphysis.

### Treatment

- The head is fixed in situ with pins or a screw

## Perthes disease

(Legg–Calvé–Perthes syndrome)

### Definition

- It is avascular necrosis of capital femoral epiphysis of the femur in children.

### Incidence

- Rare.
- **Age:** 6 – 10 years.
- 90% unilateral.

### Etiology

- Although no one has identified the cause it is known that there is reduction in blood flow to the joint.
- There are factors implicated in the pathogenesis:
  - a. Low birth weight.
  - b. High birth order.
  - c. Abnormalities in anthropometric measurements.
  - d. Delayed bone age.
  - e. Low socioeconomic status.

Recently thrombophilia secondary to protein deficiency has been cited as an etiological factor but there is a little supported evidence for this.

### Pathology

- ➔ The pathological process takes 2-4 hours to complete
  - Stage 1: ischemia and bone death
  - Stage 2: revascularization and repair
  - Stage 3: distortion and remodeling.



## Clinical Picture

### → **Type of patient:**

- Male: female 4:1.
- 5-12 years.

### → **Pain:**

- Usually in the hip but can also be felt in the back of the knee (referred pain).
- Onset of the pain up to 4 hours after inactivity and lasts for an hour and return nightly on inactivity.

### → **Limping:** intermittent or continuous for few weeks particularly when tired.

### → **Movement:** limited abduction & external rotation of the hip.

The pain is felt in some cases in the unaffected hip as the child place the majority of their weight on the good limb.

## Investigations

### → **X-ray of the hip joint are absolutely necessary**

- Early → increased density of epiphysis.
- Late →
  - Head is flat and fragmented.
  - Osteoarthritic changes.

### → **Others:**

- Bone scan.
- Hip aspiration (if septic arthritis).
- MRI → for judging the extent of deformity.



## DD

(Must be considered particularly if radiographic changes are bilateral)

### → Irritable hip:

1. Transient synovitis of hip.
2. TB of the hip.
3. Slipped upper femoral epiphysis (best seen in lateral view X-ray).
4. Iliac adenitis.

### → Coxa vara.

### → **Prognostic features (head at risk):**

- Lateral subluxation of femoral hip (the most important)
- Metaphyseal cysts.
- Gage's sign (V shaped defect laterally).
- Horizontal epiphyseal plate.

## Treatment

### ■ The average duration of the disease is 1 – 2 years.

1. **75% of cases** heal within 2 years without treatment with good to excellent outcome.
2. **non-surgical treatment** (to maximize range of movement):
  - a. Physiotherapy, analgesics, some restriction of sporting activity is advisable.
  - b. Traction method (separates femur from pelvis).
  - c. Abduction brace.

### **Causes of AVN:**

1. Steroids.
2. Infections.
3. Sickle cell disease.
4. Hypothyroidism.
5. Skeletal dysplasia.



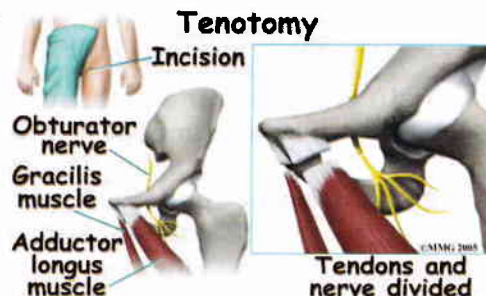
### Traction



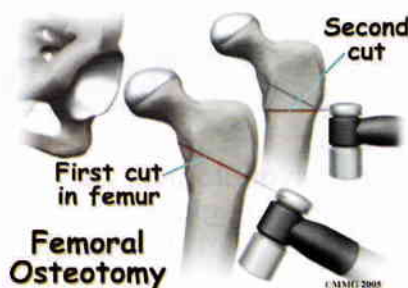
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### 3. Surgical treatment:

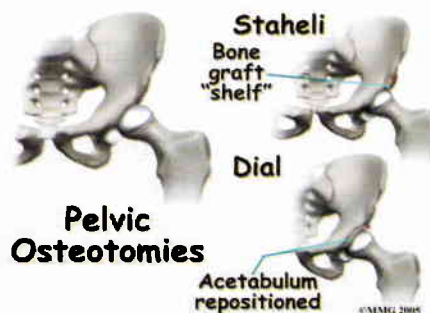
- ❖ Early → to prevent deformity as:
  - a. Failure of non-surgical treatment.
  - b. In older children who are not compliant with brace treatment (psychological).
- ❖ Late → to salvage a poor mechanical situation.
- ❖ Techniques:
  - Tenotomy (if the condition is long standing the muscle may have contracted or shrunk and can not be stretched back out).



- Femoral osteotomy.



- Pelvic osteotomy.



- Both femoral and pelvic osteotomies.

# Painful Conditions

## A. Painful Heel

### Definition

- Localized pain around the heel.

### Classification According to the Age

- 1) **10 yrs** → **Sever's disease**: apophysis of calcaneus not perfectly fused with calcaneus → traction apophysitis  
Treatment: high heel shoes
- 2) **Adolescent age (15-20 yrs)** in girls  
"Calcaneal knob": at the lateral side of foot due to rubbing of shoes with the heel  
Treatment: to avoid rubbing shoes, if large → curettage
- 3) **Young adult**:
  - Bursitis at insertion of tendoachilis
  - Acute plantar fascitis due to gonorrhea
- 4) **Older adult (40 yrs)**: "Policeman heel"  
**calcaneal spurs** → localized tenderness on heel usually due to metabolic diseases e.g. D.M or gout  
Treatment: by local injection of cortisone
- 5) **At any age**: Brodie's abscess in calcaneus.

## B. Low Back Pain (LBP)

### Causes

**A- Psychological** (30%) due to impotence or sterility

**B- Pathological**:

- 1) **Congenital**:
  - spondyloisthesis
  - Spina bifida
  - sacralization of L5
- 2) **Traumatic** → old fracture
  - Sacroiliac strain
  - Prolapsed disc
- 3) **Pathological**: osteomyelitis, spondylitis)
- 4) **Referred pain** from urogenital system.

## C. Causes of Sciatica

- (1) **Pressure on roots**:
  - Prolapsed disc (10%).
  - Tumor
  - Spondylolisthesis.
  - Collapse of body vertebra.
- (2) **Referred sciatica**: from intra pelvic condition
- (3) **1ry sciatic neuritis**
  - Infection: viral
  - Toxic
  - Allergic
  - Metabolic e.g.: D.M.

# D. Poliomyelitis

Is an orthopedic problem now

## Management

**Convalescent stage:** → prevent deformity by:

- Physiotherapy
- Passive movement and massage
- Electrical stimulation
- Night splints

**Chronic stage** (established deformities): Correction of deformity by:

(1) **Soft tissue release:**

(a) Flexion deformity of the hip:

Treatment → by "**Soutter's operation**" in which the tensor fascia lata, psoas ms. and capsule of the hip joint is released and the hip is extended & fixed in hip spica for 4 wks.

(b) Flexion deformity of the knee:

- Slight deformity (10 - 20°) → wedding plaster method
- Moderate deformity (20 - 30°) → wedding plaster then supracondylar femoral osteotomy
- Severe deformity (30 - 40°) → tenoplasty (lengthening of biceps and semitendinosus) and capsulotomy
- Very severe deformity → tenoplasty + capsulotomy followed by wedding plaster

(c) Equine deformity → lengthening of tendoachilis

(2) **Tendon transfer:**

- 1- Iliopsoas can be transferred from the lesser trochanter through a hole in the ilium to the greater trochanter in the case of completely paralyzed psoas of hip
- 2- Hamstring tendon in patella to improve knee extension in quadriceps paralysis
- 3- Peroneus tertius ms into the medial side of foot to replace paralyzed tibial ms or vice versa

(3) **Arthrodesis:** (above age of 10 yrs)

e.g.: arthrodesis of shoulder in deltoid paralysis triple arthrodesis for foot drop

(4) **Rehabilitation**



# **C H A P T E R**

# **2**

## ***Neurosurgery***

- Head injuries
- Peripheral nerve injuries
- Hydrocephalus
- Brain abscess
- Brain tumors
- Spinal dysraphism
- Cavernous sinus thrombosis
- Injuries of the spine
- Disc prolapse
- Coma
- Increased ICT

# 1-Head Injuries

A- Intracranial injuries.

B- Skull injuries.

C- Scalp injuries.

## A- Intracranial Injuries

### Mechanism of Injury



### Factors that affect the severity of cerebral injury

- 1- Distortion of the brain.
- 2- Mobility of the brain in relation to skull and meninges.
- 3- Configuration of the interior of the skull. Smooth areas will produce less damage than rough areas.
- 4- Age of the patient. A young patient has better chance of recovery than an elderly one.

### Pathological sequelae of head trauma

#### i. Primary Pathological Sequelae

(Primary lesions, which occur at the time of impact)

1. **Diffuse neuronal damage (Concussion → physiological block).**
2. **Cerebral Contusion (microscopic injury of the brain) & laceration (macroscopic injur of the brain).**

#### ii. Secondary Pathological Sequelae

(Secondary lesions, which develop later)

1. Intracranial hemorrhage.
2. Brain edema.
3. Vascular changes.
4. Coning.
5. Brain stem lesion.
6. Infection.
7. CSF rhinorrhoea.

### Extracranial factors that affect the cerebral injury

- 1- **Respiration:** respiratory inadequacy ( $\downarrow O_2$ ,  $\uparrow PCO_2$ ) can aggravate the brain edema leading to irreversible changes.
- 2- **Blood volume & blood pressure:**  $\downarrow$ cardiac output due to hypovolemia may lead to irreversible cerebral ischemic damage.
- 3- **Fluids:** patients with cerebral injury have disturbances in the BBB and  $\downarrow ADH$ . IV infusion of hypotonic fluids will decrease plasma osmolarity leading to increased brain edema.
- 4- **Temperature:**  $\uparrow$ body temperature will cause a further deterioration in neurological state due to increased metabolic demands and accumulation of metabolites.

## i. Primary Pathological Sequelae

### Early Complications of Head Injuries

#### 1- Brain Concussion

##### Definition

- It is a transient loss of consciousness, which starts with the trauma and lasts for a limited period followed by complete recovery if no other injury has occurred.
- The duration of the period of concussion depends on the severity of neuronal injury commonly few minutes. In severe head injuries, loss of consciousness may persist for several hours.

##### Mechanism

- Sudden change in velocity → vibratory wave, which affects reticular formation responsible for consciousness.

##### Clinical picture

- See extradural hemorrhage

##### Fate

- Complete recovery (common).
- Incomplete recovery (post-concussion \$).
  - (Amnesia – Headache – Drowsiness – Irritability).
  - Concussion passing to compression with Lucid interval.

##### Investigations to exclude intracranial hemorrhage

- Plain x-ray.
- CT (of choice to exclude intracranial hemorrhage).

##### Treatment

- Rest & observation for at least 48 hours.

#### 2-Brain contusions & lacerations

##### Definition

- Areas of bruising and hemorrhage due to microscopic vascular tear.

##### Clinical picture

- Prolonged unconsciousness.
- Signs of focal neurological damage.

##### Fate

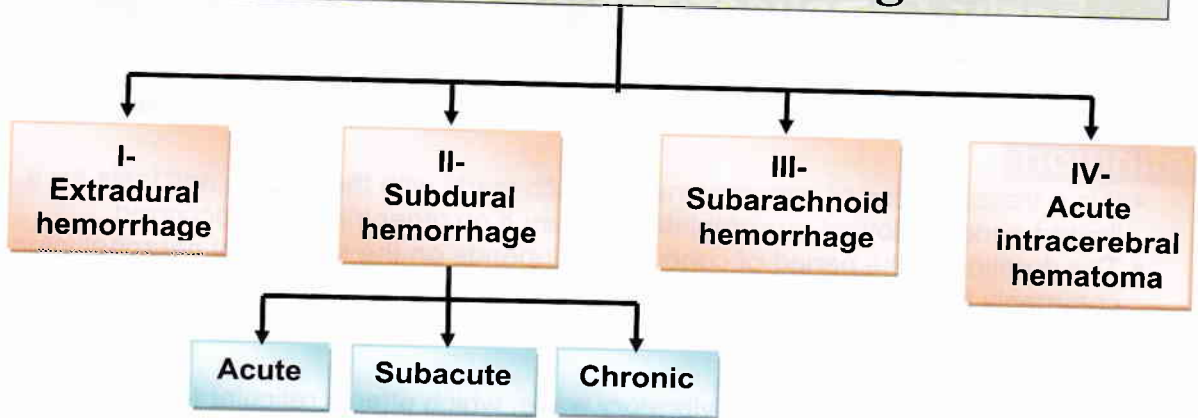
- On recovery patient complains of headache and confusion.
- Contusions are irritative to cerebral cortex so may cause epilepsy.

## ii. Secondary Pathological Sequelae

Before doing lumbar puncture we have to exclude ↑ICT for fear of development of Herniation syndrome.

## Clinical presentations of the various pathological sequelae

## Intracranial hemorrhage



## I- Extradural Hemorrhage

## Applied anatomy

## Middle meningeal artery:

- It is a branch of the maxillary artery, entering the skull through the foramen spinosum to the floor of middle cranial fossa. There it divides into:
  - Anterior branch: It passes up & forwards, lying in a bony canal at the pterion. It overlies the motor cortex (**artery of extradural hemorrhage**).
  - Posterior branch: It passes backwards to the occipital bone.

- ▶ **Etiology:** trauma to the side of head
- ▶ **C/P:** concussion → lucid interval → compression
- ▶ **Comp.:** as any head trauma (early, late)
- ▶ **Invest.:** CT → unilateral biconvex
- ▶ **TTT:** early surgery is successful

## Definition

- It is hemorrhage, which occurs between skull and dura matter, commonly in temporal or parietal regions.

## Etiology

- Usually due to trauma to the side of head either:
  - With fracture of temporal or parietal bone.
  - Without fracture especially in children as they have elastic skull.

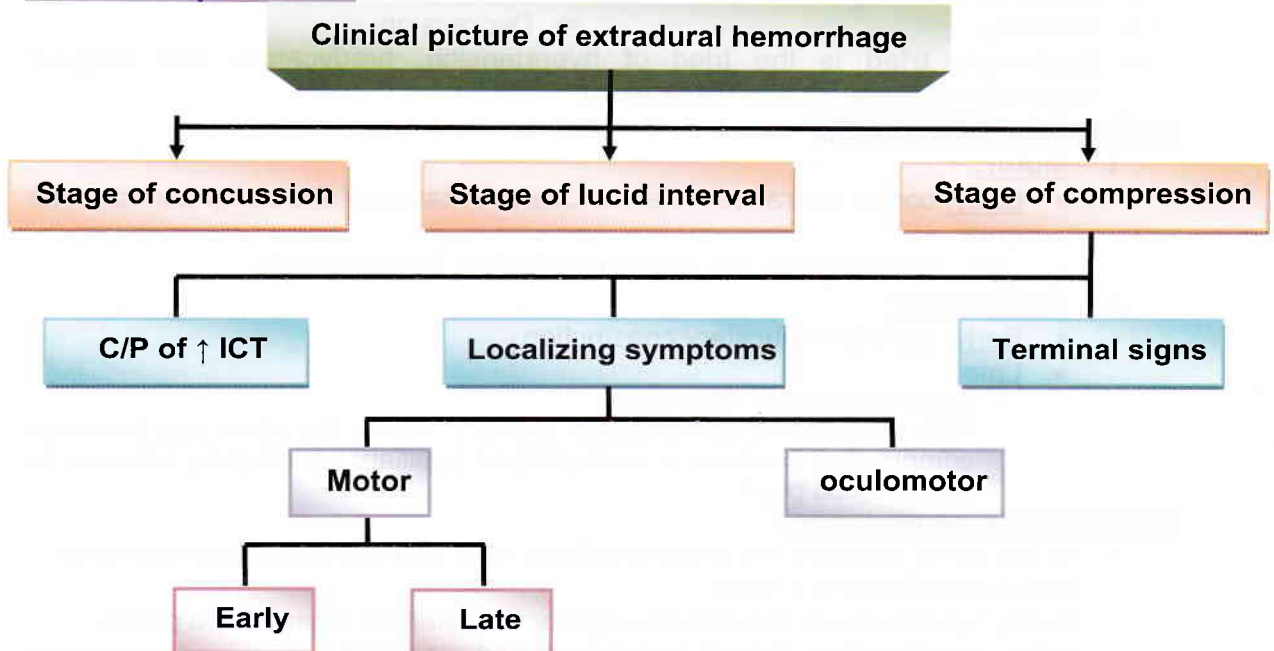


## Pathology

- Source of bleeding:
  - Middle meningeal artery, especially the anterior branch (most common).
  - Venous sinuses: profuse hemorrhage (**serious**).
  - Diploic hemorrhage: minimal (**clinically insignificant**).
- In anterior branch bleeding, blood escapes from the injured artery in 3 directions:**
  - Outwards: to form a hematoma deep to the temporalis muscle.
  - Downwards: to the middle cranial fossa
  - Upwards: over the precentral motor cortex causing convulsions followed by paralysis.

**In posterior branch bleeding, the hematoma collects away from the motor cortex; convulsions do not occur.**



**Clinical picture****A. Stage of concussion**

- a. Immediate loss of consciousness after trauma to the head.
- b. The patient falls flaccid as one block, & loses his consciousness.
- c. Vital signs:
  - i. Pulse: weak & rapid.
  - ii. ABP: ↓.
  - iii. Temp.: subnormal.
  - iv. Respiration: shallow, slow.
- d. Limbs:
  - i. Skin: cold.
  - ii. Muscles: relaxed.
  - iii. Reflexes: lost.
- e. Eyes:
  - i. Closed.
  - ii. Equal, reactive pupils.
- f. Sphincters: May relax.
- g. On recovery, pulse, temperature, blood pressure, reflexes become normal & consciousness is regained after few minutes.

**B. Stage of lucid interval**

- Period of recovery from coma of concussion followed by coma of compression.

- Lucid interval may be brief and missed
- May be longer if venous bleeding

**C. Stage of compression****1. C/P of increased ICT**

- ⇒ Gradual progressive deterioration of the level of consciousness is the main feature.
- ⇒ Headache.
- ⇒ Vomiting.
- ⇒ Nausea.

- ⇒ Behavioural changes.
- ⇒ Irritability.
- ⇒ **Cushing's triad** is the triad of hypertension, bradycardia and irregular respiration (Cheyne-Stokes respiration).
- ⇒ Drowsiness.
- ⇒ Depression.

## 2. Localizing symptoms

### i. Motor:

- Early: contra-lateral convulsions due to irritation of the compressed motor area.
- Late: hemiplegia on the opposite side then the same side.

### ii. Oculomotor:

- Early: ipsilateral pupillary constriction..
- Late:
  - Ipsilateral dilated fixed pupil.
  - With progressive compression of the 3<sup>rd</sup> nerve the other side becomes compressed so there is contralateral pupillary constriction followed by dilated fixed pupil.

## 3. Terminal Compression

- As the coma deepens the blood pressure rises and the pulse and respiration slow down (Cushing's triad).
- Finally hyperpyrexia, decerebrate rigidity and bilateral dilated fixed pupils occur, and constitute clinical evidence of bad prognosis

It should be stressed that this classic picture is only found in a minority of patients.

## DD

- *Acute subdural hemorrhage (see later)*

## Complications (may occur in any head trauma)

### Early

1. Intracranial hemorrhage.
2. Brain edema.
3. Dural tear leading to prolapse of the brain and cerebrospinal rhinorrhea & otorrhea.
4. Carotid - cavernous fistula.
5. Metabolic disturbances & diabetes insipidus.
6. Intracranial infection: Osteomyelitis - Meningitis - Brain abscess.
7. Traumatic paralysis of cranial nerves.
8. Associated spinal injuries (whiplash injuries).

### Late

1. **Post traumatic headache:**
2. **Post traumatic epilepsy.**
3. Skull defects → cosmetic deformities.
4. Traumatic meningo-encephalocele (growing skull fracture).
5. Post traumatic hydrocephalus.
6. Chronic Subdural hematoma (see below).
7. Aneurysm formation.

## Causes of Death

### Immediate Deaths

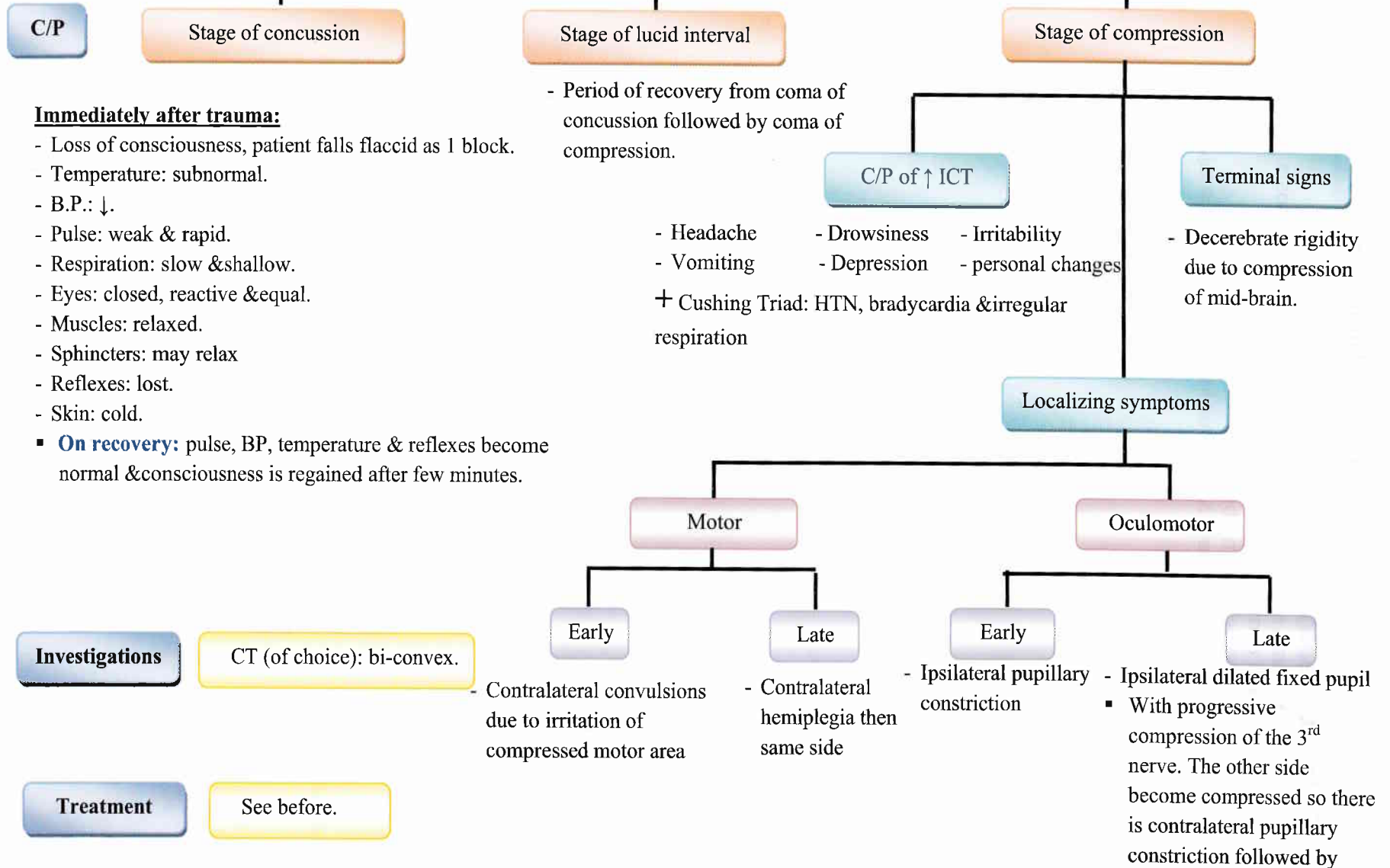
**Causes:** due to severe injuries, for example:

- Primary brain stem hemorrhage and contusions
- Lacerations of the hypothalamus

### **Delayed Deaths** Causes: due to:

- Intracranial hematoma, which have escaped diagnosis.
- Chest complications.
- Meningitis & brain abscess.
- Metabolic disorders & diabetes insipidus. - Multiple injuries.

## Management of Extra-dural Hge





## II- Acute Subdural Hemorrhage

### Etiology

- Usually due to severe trauma ,less commonly with cerebral laceration.

### Incidence

- It is the least common of traumatic intracranial hematomas.

### Pathology

### Source

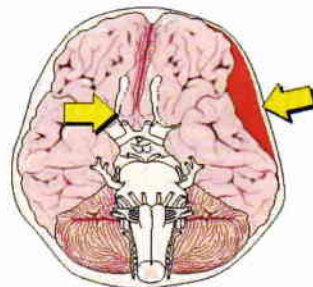
- Usually from rupture of a large cortical vein as it crosses the subdural space.

### Site

- Commonly bilateral & extensive.

### Clinical Picture

- ▶ **Etiology:** severe trauma
- ▶ **C/P:** bilat. & extensive. Loss of consciousness without lucid interval
- ▶ **Invest.:** CT → crescentic
- ▶ **TTT:** surgical with poor results (50%)



|                         | Acute extradural hematoma             | Acute subdural hematoma                                                                                                                                        |
|-------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Etiology</b>         | - Usually mild trauma.                | - Severe trauma.                                                                                                                                               |
| <b>Clinical picture</b> | - Usually mild brain damage.          | - Severe brain damage & laceration.                                                                                                                            |
|                         | - Lucid interval may be present.      | - Persistent loss of consciousness, no lucid interval.                                                                                                         |
|                         | - The hematoma is usually unilateral. | - Commonly bilateral and extensive (coup & contre-coup).                                                                                                       |
| <b>Investigations</b>   | - CT → <b>biconvex</b> .              | - C.T → <b>crescentic</b> . (concavo-convex)                                                                                                                   |
| <b>Treatment</b>        | - Early surgery is successful.        | - The patient has serious brain damage and edema in addition to the hematoma, and so results of surgery are not very successful. Mortality rate is up to 50 %. |
| <b>Prognosis</b>        | - Better prognosis                    | - Worse prognosis                                                                                                                                              |

- Signs can be misleading because of the extent of the underlying brain damage.

### Complications

- As extradural hemorrhage.

### Investigations

- CT scan.



### III- Subarachnoid Hemorrhage

#### Causes

- **Traumatic** (most common cause)
- **spontaneous**
  - Rupture aneurysm (50%).
  - Hypertensive disorders.
  - Bleeding tendencies.
  - Malignant tumors.
  - A-V malformations.

- ▶ **Etiology:** traumatic\*, spontaneous
- ▶ **C/P:** headache, mening. irritation, focal defects
- ▶ **Invest.:** CT, angiography, lumbar puncture
- ▶ **TTT:** conservative, surgical evacuation, comp.



The white arrow on the black card marks the site of a ruptured **berry aneurysm in the circle of Willis**. This is a major cause for subarachnoid hemorrhage

#### Clinical Picture

- **Headache:** sudden severe splitting, agonising headache accentuated by flexion of neck followed by sudden loss of consciousness with no recovery or may recover → then deteriorate (arterial spasm).
- Symptoms & signs of meningeal irritation e.g. photophobia, neck stiffness & Kernig's sign.
- General symptoms: nausea, vomiting, vertigo & fever.
- Focal defects.
- Sudden death within (6) wks of hemorrhage (= 2nd fatal attack).

#### Investigations

- **CT-scan:** is the 1<sup>st</sup> investigation to be done, if blood is detected diagnosis is settled and lumbar puncture is not needed.
- **Angiography:** (performed within few days after hemorrhage) to diagnose bleeding vessel or AVM.
- **Lumbar puncture:** high pressure, bloody CSF + Xanthochromia.

#### Treatment

- Conservative.
- Of the cause → Surgical (microscope) : evacuate hematoma, obliterate aneurysm.
- Of complications e.g. hydrocephalus: VPS (ventriculo-peritoneal shunt).

### IV-Chronic Subdural Haematoma

#### Incidence

- More common than extradural hemorrhage.
- More common in old age (due to brain atrophy) / alcoholics.
- Bilateral in 50% of cases.

- ▶ More common than extradural hemorrhage
- ▶ **Etiology:** mild blow to the head in elderly
- ▶ **C/P:** vague symptoms long time after trauma
- ▶ **Invest.:** CT, fundus examination
- ▶ **TTT:** evacuation

#### Etiology

- Slight blow to the head, which may pass unnoticed in elderly alcoholics.

#### Pathology

- It results usually from rupture of the superior cerebral veins as a result of sudden displacement of the brain within the skull.
- **Cause:** Minor trauma to the front or back of the head, not enough to produce a fracture or even concussion.

### Clinical picture

- ➔ The interval between the trauma and the symptoms varies between weeks to months.
- ➔ The symptoms are vague and consist of chronic headache, mental apathy, slowing of cerebration and the patient may even develop stupor.
- ➔ Physical signs may be absent or at most there may be unilateral or bilateral extensor plantar response. Pupillary changes are late and denote impending conization.
- ➔ The symptoms and signs wax and wane. The condition may be diagnosed as psychosis or cerebrovascular accident.

### DD

- Other causes of increase intracranial tension.

### Investigations

- CT is the investigation of choice (hematoma will appear as hypodense area).
- Fundus examination → . Papilloedema is not common.

### Treatment

- Evacuation through burr holes.

## Management of intra-cranial injuries

### A- Dealing with life saving priorities (primary survey):

- ABCDE.
- It is also to be stressed that the patients with a head injury are more likely to die from airway obstruction than from any remediable intracranial lesions.

1. 1ry & 2ry survey □ trauma
2. Invest.: as trauma esp. CT scan
3. Continuous care & observation:
  - Airway
  - ryle, line, catheter
  - diuretics, corticosteroids
4. Surgical evacuation

### B- Secondary survey:

#### 1- Exposure:

- Of the patient to detect any soft tissue, vascular or orthopedic injury.
- This phase aims at resuscitation & monitoring of polytraumatized patient.

#### 2- Head to toe examination of undressed and stable patient:

- Head examination.
  - o Scalp → For any scalp wound or hematoma.
  - o Skull → for any fracture
  - o Pupils → if dilated initially → direct injury to orbit or oculomotor nerve.
- Neurological: Glasgow coma scale.
  - ⇒ The total points are added. The higher the score, the better is the prognosis.
  - o Mild → (13-15)
  - o Moderate → (9-12)
  - o Severe → with a score of 8 or less.
- Neck: neck collar for fixation.
- Chest: pneumothorax, hemothorax, cardiac tamponade.
- Abdomen.
- Back
- Limbs: for fractures and neurovascular bundle.

The presence of shock in a patient with a head injury is most likely due to internal haemorrhage in the thorax or abdomen.



**C- Investigations:**

- a. CT scan (of choice):
  - i. Diagnosis of EDH (usually biconvex).
  - ii. Shows the severity.
  - iii. Site and associated lesions.
- b. Plain X-ray: skull, chest & cervical spine.
- c. Laboratory investigations: especially renal functions to assess patient's general condition.

If the patient, on clinical grounds, is in urgent need for evacuation of an intra-cranial hematoma, no time should be lost in doing investigations, and surgery should be done immediately.

**D- Continuing care and observation:****➡ Aim:**

- ▣ To give the patient the maximum care until spontaneous recovery occurs and to detect, at the earliest possible moment, the development of complications that may need surgical interference.

**1- Attention to the airway :**

- ▣ If spontaneous respiration is inadequate to keep the normal levels of PO<sub>2</sub> and PCO<sub>2</sub>, an endotracheal tube is inserted and controlled ventilation started.
- ▣ An endotracheal tube needs full sedation or even muscle relaxants. It can be left for a period up to 7 days.
- ▣ If ventilation is needed for a longer , a tracheostomy is performed.

**2- A foley's catheter is inserted to facilitate the nursing care and to estimate the urine output.****3- Frequent change of posture to avoid bed sores.****4- Physiotherapy to the joints and massage to the muscles.****5- A nasogastric tube is inserted for feeding.****6- Osmotic diuretics : These raise the osmolarity of the plasma and so reduce the brain oedema. 250ml of 20% mannitol are given over a period of 20 minutes and may be repeated every 8 hours. Before mannitol is administered, it is essential to exclude an intracranial haematoma and to check that the renal function is satisfactory. Mannitol should not be used for more than 48 hours to prevent rebound oedema and electrolyte disturbances.****7- Furosemide: 40-80 mg IM is an alternative to mannitol.****8- Corticosteroids. These are empirically prescribed but there is no clear evidence that they reduce the cerebral oedema nor improve the outcome in patients with severe head injury.****➡ Repeated observations for the following :**

- Level of consciousness using Glasgow coma scale.
- Pulse, B.P., and temperature.
- Respiration.
- Pupils.
- Reflexes.

**➡ Causes of deterioration of the patient :**

- 1- Brain edema → leading to increased intracranial tension.
- 2- Airway obstruction and/or hypoventilation leading to brain swelling and increased intracranial tension. Respiratory insufficiency can be confirmed by estimating PO<sub>2</sub> and PCO<sub>2</sub>.
- 3- Intracranial haematoma → This can be confirmed by CT scan.
- 4- Fever due to respiratory infection or meningitis.



- 5- Overtransfusion by hypotonic fluids or dehydration.
- 6- Epilepsy → If not accompanied by convulsions, it is difficult to differentiate epilepsy from an intracranial haematoma.

### **E- Surgery to evacuate an acute intracranial haematoma**

#### **➡ Operation**

- 1- The operation is done under general anaesthesia with endotracheal intubation.
- 2- The Patient is placed supine with the sites of the haematoma uppermost, and the head is raised slightly to reduce venous bleeding.
- 3- A formal craniotomy by an osteoplastic flap is done. The flap includes skin, temporalis muscle and part of skull. Four or five burr holes are done and are connected by a saw.
- 4- Skin and temporalis are not dissected from bone. The whole osteoplastic flap is turned down, thus exposing the dura.
- 5- If an extradural haematoma is present, it can be removed by suction and the middle meningeal artery coagulated or under-run by a stitch.
- 6- Occasionally it may be necessary to follow the middle meningeal artery to the foramen spinosum which is packed with bone wax.
- 7- If a subdural haematoma is found, the dura matter is opened in a cruciate fashion to allow rapid decompression of the brain.
- 8- A drain is placed S.C. and the flap is returned to its place and fixed by suturing temporalis fascia and skin.
- 9- Prophylactic anticonvulsant drugs are prescribed for 6 weeks to guard against epileptic fits.

## Late Complications of Head Injuries

### 1- Brain edema

- ➔ Clinically this simulates the picture of brain compression due to surface hematoma, yet without focal manifestations.

### 2- Vascular changes

- ➔ The rising intracranial pressure disturbs the cerebral blood flow, with resultant ischemic necrosis and subsequent brain edema.
- ➔ Cerebral infusion pressure= B.P – intracranial pressure

### 3- Coning

- The rise of intracranial pressure will cause:
  - 1- Herniation of the contents of the supratentorial compartment** through the tentorial hiatus → tentorial herniation "lateral herniation" → Leads to → 1- Compression of oculomotor nerve → constriction then dilatation of the ipsilateral pupil  
2- Compression of the midbrain  
3- Compression of descending motor pathways from the opposite hemi-sphere → hemi-plegia on the same side of heamatoma
  - 2- Herniation of the contents of the infratentorial compartment** through the foramen magnum → foramen magnum herniation "central herniation" → compression of the vital centers in the medulla → ↓pulse, RR, ↑BP, severe headache and neck rigidity are present.

### 4-Brain stem injury

#### Etiology

- Primary damage to the brain stem (medulla and pons)
- Secondary damage due to unrelieved supratentorial herniation.

#### Diagnosis

- The patient is unconscious with spontaneous extension spasms of all four limbs. opisthotonus, tachycardia, small pupils, pyrexia and rapid shallow breathing.

#### Treatment

- With intensive treatment, the patient may recover but there is often marked spasticity.

### 5-Infection

#### Etiology

- This complication is liable to occur in patients with compound fractures or fractures of the base especially if there is CSF rhinorrhoea or otorrhoea.

#### Complications

- The usual complication is meningitis which may develop 2-3 days after the injury and manifests by fever and neck stiffness. (Meningitis can be confused with subarachnoid hemorrhage)

## Investigations

- Diagnostic lumbar puncture will establish the diagnosis.
- Brain abscess is a possible sequel of infection.

## 6-CSF Rhinorrhoea

### Etiology

- This occurs secondary to a fracture involving the paranasal sinuses, frontal, ethmoid or sphenoid associated with a dural tear.

### Pathology

- A piece of brain tissue is forced into the dural tear and prevents its healing.
- Complications:
  - This complication is liable to be followed by meningitis.

### Treatment

- The patient is treated initially by antibiotics.
- Indications for surgical interference include :
  - Persistence of the rhinorrhoea more than 10 days
  - The presence of a fracture involving the frontal or ethmoid sinus
  - The occurrence of meningitis.

### ➔ EXTRACRANIAL FACTORS THAT AFFECT THE CEREBRAL INJURY:

- 1- Respiration.
- 2- Blood volume and blood pressure.
- 3- Fluids(Patients with cerebral injury have disturbances in the blood brain barrier and inappropriate secretion of ADH. Intravenous infusion of hypotonic fluids in these patients will lower the plasma osmolality leading to increased brain oedema and swelling.)
- 4- Temperature.

## 7-Post-traumatic Headache

- ➔ Patients with serious head injury usually have some residual symptoms as headache, giddiness, impaired sleep and defective concentration.
- ➔ These patients need prolonged convalescence.

## 8-Post-traumatic Epilepsy

- ➔ This may be either :
  - A. Early:**
    - Within one week after the injury.
    - Its incidence is increased in patients with depressed fracture or intracranial haematoma.
    - These patients need prophylactic anticonvulsants for 6 weeks.
  - B. Late epilepsy:**
    - The incidence of which is much higher in those who had early epilepsy.
    - It occurs within 1-4 years after the injury.
- ➔ **Treatment:** long term anticonvulsant drugs.

## 9-Post-traumatic hydrocephalus

- ➔ This may need shunt operation.

## More details

### ✿ HOW TO DETERMINE THE SIDE OF TRAUMA? (SIGNS OF LATERALIZATION)

- 1- The side of external trauma (counter-coup is an exception)
- 2- The side of initial constriction and dilation of the pupil.
- 3- The contralateral side of convulsions.
- 4- The contralateral side of hemiparesis.
- 5- The side of skull fracture in the X-ray.
- 6- CT scan: **investigation of choice.**

### ✿ EXAMINATION OF HEAD INJURY:

- Glasgow coma score.
- Pupil size & response.
- Lateralizing signs.
- Signs of fracture base:
  - Bilateral periorbital edema.
  - Battle's sign.
  - CSF rhinorrhea or otorrhea.
  - Hemotympanum or bleeding per ear.
- Full neurological examination: tone, power, sensation & reflexes.

| <i>Glasgow Coma Scale</i> |                    |                                           |                                     |                                         |                              |                |
|---------------------------|--------------------|-------------------------------------------|-------------------------------------|-----------------------------------------|------------------------------|----------------|
|                           | 1                  | 2                                         | 3                                   | 4                                       | 5                            | 6              |
| Eyes                      | Does not open eyes | Opens eyes in response to painful stimuli | Opens eyes in response to voice     | Opens eyes spontaneously                | —                            | —              |
| Verbal                    | Makes no sounds    | Incomprehensible sounds                   | Utters inappropriate words          | Confused, disoriented                   | Oriented, converses normally | —              |
| Motor                     | Makes no movements | Extension to painful stimuli              | Abnormal flexion to painful stimuli | Flexion / Withdrawal to painful stimuli | Localizes painful stimuli    | Obeys commands |

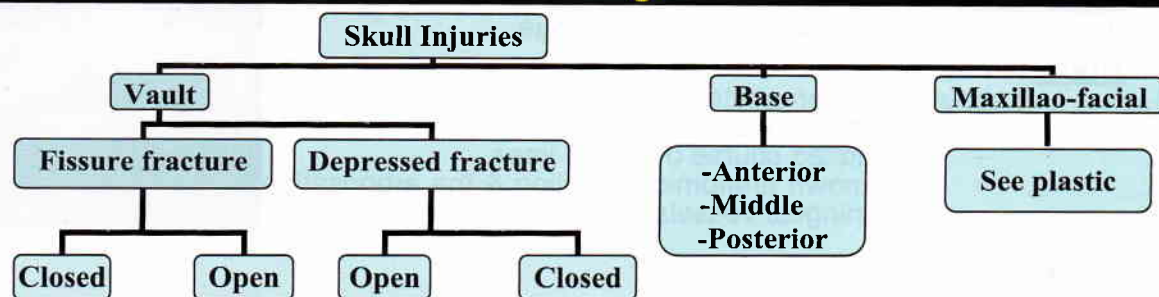
→ The scale comprises three tests: eye, verbal and motor responses. The three values separately as well as their sum are considered. The lowest possible GCS (the sum) is 3 (deep coma or death), while the highest is 15 (fully awake person).

#### → Generally, brain injury is classified as:

- Severe, with GCS  $\leq 8$
- Moderate, GCS 9 - 12
- Minor, GCS  $\geq 13$ .



## B- Skull Injuries



### I-Fracture Vault

### I- Fissure (linear) fracture

#### Cause

Blunt trauma where force applied over a wide surface area. It usually runs away from site of impact, may extend to skull base.

- ▶ **Etiology:** blunt trauma to wide surface area
- ▶ **Diagnosis:** - **closed:** X-ray, CT  
- **open:** seen through scalp wound
- ▶ **Comp.:** hemorrhage
- ▶ **TTT:** as any trauma + ttt of wound

#### Types

#### According to shape

- Linear.**
- Stellate**

**Diastatic Fracture:** linear fracture extending to suture (more common in children)

#### According to presence of external wound

- Closed (Simple).**
- Open(compound):** with scalp wound.

#### Diagnosis

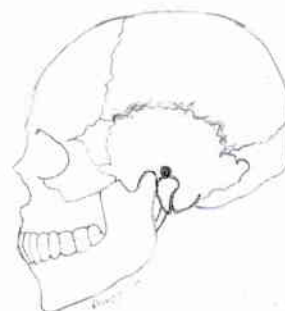
- Closed fracture:** the patient usually presents with the clinical picture of the associated brain damage. → diagnosed by X-ray or CT.
- Open fracture:** It is seen through the scalp wound (the fissure may extend far beyond the wound.).

#### Complications

- Could be potentially serious and can be fatal if it crosses major vascular channels in the skull as the groove of MMA or dural venous sinuses.

**It should be differentiated from suture line by:**

- The anatomical site of suture line.
- The suture line is zigzag & does not bleed.



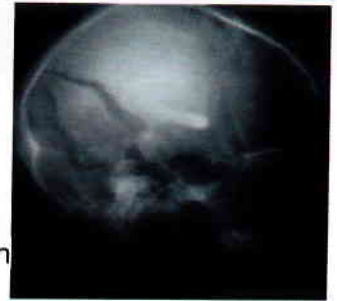
## Investigations

**CT scan:** (the investigation of choice); to detect any associated lesions as extradural hemorrhage.

### Plain X-ray:

It should be differentiated from suture lines by:

- The known anatomical position of suture lines.
- The zigzag course of suture lines.
- The known anatomical position & the arborisation of meningeal vessels.



## Treatment

### First Aid (ABCD)

#### Primary survey

⇒ As before

#### Secondary survey

⇒ As before

### At hospital

⇒ **Conservative Treatment:** see extradural hemorrhage.

⇒ **Definitive treatment:**

- **Closed fissure:** Hospitalize & exclude extradural hemorrhage.
- **Open fissure:** as any scalp wound & observe for evidence of intracranial injury.

## II- Depressed fracture

### Definition

It is localized fracture and indentation of the skull.

### Causes

- **Blunt trauma:** a localized force, concentrated over a relatively small area of the skull.
- **Missile injuries.**

- ▶ **Etiology:** blunt trauma to small area
- ▶ **C/P:** - **closed:** H/O of trauma + hematoma
  - **open:** lacerated scalp + fracture
- ▶ **Invest.:** X-ray, CT scan
- ▶ **TTT:** as any trauma +
  - **Simple:** conservative
  - **Open:** surgical

### Clinical Types

The inner plate of the skull is fractured before the outer plate

#### 1. Closed depressed fracture (rare in adults)

- Due to trauma caused by blunt rounded object.
- It occurs in infants or children.
- There is usually an overlying hematoma which may obscure the fracture.
- It rarely causes cerebral compression.

#### 2. Open (compound) depressed fracture: (with or without CSF leakage)

- Caused by localized sharp object or severe blunt object.
- **Clinically:**
  - A depressed fracture is usually compound because the trauma which causes depression usually results in laceration of the scalp.



## Clinical picture

1. History of trauma
2. Pain
3. Swelling
4. There may be profuse bleeding, leakage of CSF and prolapse of a portion of the brain (more with open type).

## Complications

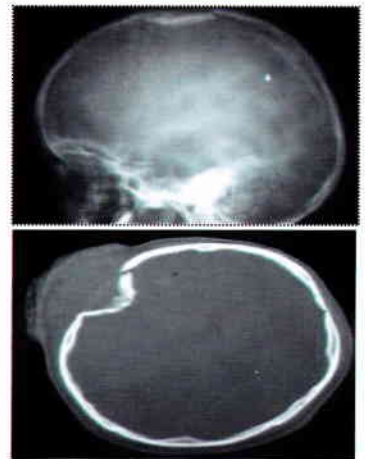
1. **Dural tear:** CSF and brain herniation.
2. **Infection:** meningitis and osteomyelitis (the most serious).
3. **Epilepsy.**
4. **Cosmetic deformity.**
5. **Severe bleeding** from one of venous sinuses

Although any complication may occur, concussion & compression are rare.

## Investigations

- B- **Plain x-ray.**
- C- **CT scan** (although plain X-ray may diagnose the depressed fracture in conscious patient, CT is still needed to exclude any associated intracranial problems e.g. EDH).

## Treatment



### First aid Treatment (ABCD)

### Primary survey

⇒ As before

### Secondary survey

⇒ As before

### At hospital

⇒ **Conservative treatment:** see extradural hemorrhage.

⇒ **Surgical treatment:**

**A- Simple depressed:** observe for intracranial injuries unless there is indication of surgery.

- **Indications:**

- Large depressed segment > 1 inch.
- If the depression lies over the motor area or speech centre.
- Associated brain damage or dural tear.
- If the depressed segment is causing a cosmetic deformity, e.g. in the frontal bone.
- If the fracture is overlying an air sinus.

- **Technique:** raise the depressed fracture.

**B- Compound depressed:**

- **Technique (operative theater + complete aseptic conditions + general anesthesia)**

- 1- Foreign bodies are removed.
- 2- The depressed segment is gently elevated to avoid tearing of the dura and any prolapsed or necrotic brain tissues is sucked and hemostasis is performed.
- 3- Any dural tear is repaired.

- 4- Removed bone segments may be cleaned & replaced.
- 5- If the depressed bone is comminuted, cranioplasty may be performed.
- 6- The pericranium & the scalp sutured.
- 7- Prophylactic antibiotics are administered.
- 8- Any Intracranial lesion MUST be managed.

The most important cover to the brain is **DURA** and every attempt should be made to preserve it and close it.

### Pond fracture

- It is a simple depressed fracture in children.
- The bone is usually indented rather than fractured.
- The dura usually intact.
- This type of fracture usually corrects itself by time with growth of the skull.

### Comparison of simple & compound depressed fractures

|                                               | Simple depressed                                                                                       | Compound depressed                                                                                                                                                                                                                                                       |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cause</b>                                  | Blunt rounded object.                                                                                  | Localized sharp object or severe blunt object.                                                                                                                                                                                                                           |
| <b>Age</b>                                    | Common in infants & children (ping-pong).                                                              | Common in adults (stronger skull).                                                                                                                                                                                                                                       |
| <b>Associated lesions &amp; complications</b> | <u>Less common:</u> <ul style="list-style-type: none"> <li>- Mostly overlying hematoma.</li> </ul>     | <u>More common:</u> <ul style="list-style-type: none"> <li>- Scalp → profuse bleeding.</li> <li>- Dura: CSF leakage, brain herniation &amp; infection.</li> <li>- Cerebral cortex: contusion &amp; epilepsy</li> <li>- Venous sinus: intracranial hemorrhage.</li> </ul> |
| <b>Treatment</b>                              | <ul style="list-style-type: none"> <li>- Conservative.</li> <li>- Elevation when indicated.</li> </ul> | <ul style="list-style-type: none"> <li>- Surgical interference</li> <li>- Cranioplasty: (in depressed comminuted fracture).</li> </ul>                                                                                                                                   |

### Comparison of fissure fracture & depressed fracture

|                             | Fissure (linear) fracture                                                                                              | Depressed fracture                                                                                                                                                     |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Instrument e.g.</b>      | - Head trauma to the wall                                                                                              | - Head trauma with a hammer                                                                                                                                            |
| <b>Contact surface area</b> | - Wide                                                                                                                 | - Small                                                                                                                                                                |
| <b>Site</b>                 | - Starts at site of impact & runs away from it                                                                         | - Localized under site of impact                                                                                                                                       |
| <b>Complications</b>        | - Less common                                                                                                          | - Common                                                                                                                                                               |
| <b>Treatment</b>            | <ul style="list-style-type: none"> <li>- Conservative</li> <li>- Treatment of associated lesions if present</li> </ul> | <ul style="list-style-type: none"> <li>- Elevation if indicated + of associated lesions if present.</li> <li>- Cranioplasty if there is comminution of bone</li> </ul> |



## 2- Fracture Base of the Skull

- **Etiology:** direct, indirect trauma
- **C/P:** blood, CSF, cranial nerves
- |                 |       |                                                                                     |
|-----------------|-------|-------------------------------------------------------------------------------------|
| Ant.: eye, nose | nose  | I, III, IV, V (ophthalmic)                                                          |
| Middle: ear     | ear   | 5 <sup>th</sup> (mand. & max.), 6 <sup>th</sup> , 7 <sup>th</sup> , 8 <sup>th</sup> |
| Post.: nape     | mouth | 9 <sup>th</sup> , 10 <sup>th</sup> , 11 <sup>th</sup>                               |
- **Invest.:** X-ray, CT scan
- **TTT:** as trauma, antibiotics, control of CSF leakage

### Etiology

#### I. Indirect trauma: (the most common)

1. **Trauma to the spine:** fall on the heels or buttocks pushes the spine against posterior cranial fossa.
2. **Trauma to the chin:** the mandibular condyle transmits trauma to the glenoid cavity (middle cranial fossa).
3. **Trauma to the vault:** produces fracture in the base by extending to the bone.

#### II. Direct trauma: (rare)

- Due to penetrating sharp objects or bullet through the orbit, nose, mouth, pharynx, occiput.

### Pathology

- ✚ **Sites:** fracture base may occur in the anterior, middle or posterior cranial fossae.
- ✚ **Shape:** the fracture is usually a fissure, which runs through the weak points.

### Types

#### A. Closed: rare.

- There are 3 groups of associated lesions: i.e. 3x2
- **2 In** : infection, air enter the dura (Pneumocephalus)
  - **2 Out** : blood & CSF.
  - **2 Injured** : brain injury, cranial nerve injury except 12<sup>th</sup> CN.

#### B. Open:

- It is more common (why?)
  - o Because the dura is firmly adherent to the skull base than to the skull vault.
- Anterior cranial fossa is mainly related to the nose.
- Middle fossa is mainly related to the ear.
- Herniation of cranial contents.
- Injury to cranial nerves.
- Signs of brain injuries.

### Clinical Picture

The manifestations of a fracture base are any or a combination of the 3 groups of signs in each cranial fossa

#### 1- Anterior Cranial Fossa

##### 1- Blood:

- o Subconjunctival hemorrhage (panda bear or Raccoon sign).
- o Epistaxis: if affects cribriform plate.



|                                                       | Subconjunctival hemorrhage due to local trauma   | Subconjunctival hemorrhage due to fracture base                            |
|-------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------|
| <b>1. History</b><br>-Trauma<br>-Conscious.<br>-Onset | - To the eye.<br>- Not affected.<br>- Immediate. | - To the head.<br>- Loss of conscious.<br>- Delayed.                       |
| <b>2. Shape</b>                                       | -Triangular, base to cornea.                     | - Triangular apex to cornea.<br>-The eye may be pushed forward (proptosis) |
| <b>3-Post limit</b>                                   | - Definite.                                      | - Can not be seen.                                                         |
| <b>4- Color</b>                                       | - Bright red.                                    | -Dark red.                                                                 |
| <b>5-movement</b>                                     | -----                                            | Limitation of movement of eyeball                                          |

**2- CSF:**

- o Traumatic rhinorrhoea may persist for weeks & patient complains of persistent salty taste. Air may enter the cranial cavity when the patient blows his nose (pneumocephalus)

**3- cranial nerve injury:** any of the following cranial nerves may be affected;

- o I, III, IV & Ophthalmic branch of V cranial nerves.

- Optic nerve usually escapes as it is protected by the bony canal (Optic canal).
- CN III injury causing dilated pupil in conscious patient

**2- Middle Cranial Fossa**

- ➔ Escape of blood and CSF from the ear is the most common and characteristic sign.

**1- Blood**

- Discoloration over mastoid process (battle's sign).
- There may be surgical emphysema.
- Epistaxis occurs if the fracture involves the nasal sinuses.
- **D.D.:** bleeding from ruptured drum → it clots rapidly.

**2- CSF**

- Escape of CSF and blood from the ear is common (drips for days without clotting)

**3- Cranial nerve injury**

- Mandibular and maxillary divisions of the 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> or the 8<sup>th</sup> nerve may be injured.

- 4- Surgical emphysema may occur around and behind the ear if the fracture involves the mastoid antrum.

**3- Posterior Cranial Fossa****1-Blood:**

- May occur in the suboccipital region producing a boggy swelling or discoloration at the nape.

**2-CSF:**

- CSF may escape from the mouth.

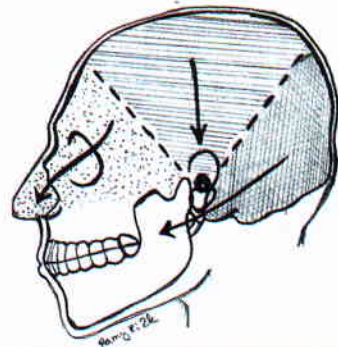
**3-Cranial nerve injury:**

- 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> may be injured in jugular foramen.

**4-patient usually is deeply unconscious due to injury of pons & medulla****5-Subtentorial hemorrhage may lead to death due to severe bulbar compression**

- 6-The upper cervical nerves are sometimes irritated by blood producing retraction of the head and stiffness of the cervical muscles

12<sup>th</sup> nerve in the condyloid foramen is protected by the condylar process.



Sites of Hemorrhage &amp; escape of CSF

## Complications of fracture base

- Extradural hemorrhage

## Investigations

- **Plain x-ray.**
- **CT Scan:**
  - Fractures in the base.
  - Any associated intracranial injuries (of an important value in head injuries).

## Treatment of fracture base

### First aid Treatment (ABCD)

#### Primary survey

⇒ As before

#### Secondary survey

⇒ As before

#### At hospital

⇒ **Conservative treatment:** as extradural hemorrhage.

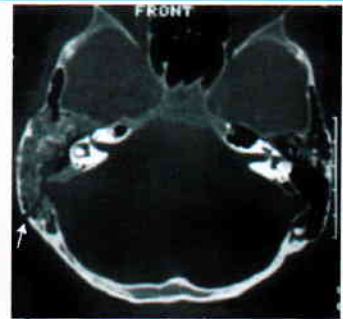
⇒ **Definitive treatment**

#### 1. Prevention of infection

- Prophylactic antibiotics: should be started at once & continued for one week after cessation of bleeding or CSF leakage.

#### 2. Control of CSF leakage

- Cerebrospinal rhinorrhoea → semi-sitting position & avoid blowing.
- Cerebrospinal otorrhoea → lie on the opposite side & clean dry dress is applied on (not inside) the ear.
- Usually the leakage stops spontaneously in 85% of cases of rhinorrhoea and in 95% of cases of otorrhoea.
- If leakage from the nose persists for more than 10 days, the torn dura is grafted by fascia lata to avoid infection.
- Bed rest for at least 3 weeks and no work resumption before at least 2 months.



3. Treatment of the associated brain injury (**as before**).

|                                  | Fracture Vault                                                        | Fracture Base of the Skull                                                              |
|----------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>Compressing hematoma(EDH)</b> | Common                                                                | Rare                                                                                    |
| <b>Types</b>                     | Closed or open                                                        | Open>closed                                                                             |
| <b>Infection, Pneumocephalus</b> | Less common                                                           | Common                                                                                  |
| <b>Bleeding/ nose, ear</b>       | Less common                                                           | Common                                                                                  |
| <b>Associated nerve injury</b>   | Rare                                                                  | Common                                                                                  |
| <b>Associated brain injury</b>   | Close to or near fracture. Opposite side in contre-coup               | May be away from fracture. Site in indirect fracture base                               |
| <b>Treatment</b>                 | Elevation of depressed TTT of associated injury (dural tear, EDH....) | Aiming to control: CSF leak, Infection. TTT of associated injuries (brain & cranial ns) |

MRI is superior to CT in demonstration of anatomical details and addition of sagittal cuts, while CT is superior in bone visualization.

## C- Scalp wounds

➔ **These may be contusions, hematomas, lacerations or incised wounds.**

- ▣ They are caused by sharp or blunt instruments or falls on the head.
- ▣ Bleeding is very excessive up to causing shock.
- ▣ Healing is rapid.
- ▣ If infection occurs in the area of loose areolar tissues, extensive cellulitis may occur.

- ▶ **Etiology:** blunt or sharp trauma, fall on head
- ▶ **C/P:** H/O, pain, swelling, bleeding ± shock ± cellulitis
- ▶ **Management:** as any trauma +
  - **General:** Control & Compensate for blood
  - **Local:** Clean & repair the wound

### Management

#### Management of polytraumatized patient

- **Prehospital management:** ABCD (see before)
- **1ry survey:** ABCD
- **2ry survey:** see before

#### General

- ⇒ **Profuse bleeding:**
- Cannula & IV saline.
  - Blood in severe cases with shock.

#### Local

- I. **Temporary stop bleeding by:**
  - a- Direct compression.
  - b- Series artery forceps on galea edge → allowed to fall back → kink vessels.
- II. **Prepare the patient:**
  - a- Wash the wound with saline and savlon (sterilization).
  - b- Shave the skin around the wound.
  - c- Examine the wound base and edges for any foreign bodies and examine the bone for any fractures.





**III. Repair the wound:**

- a- Trim the edges.
- b- Local infiltration anesthesia.
- c- Close in 2 layers:
  - Galea to galea → by absorbable sutures.
  - Skin to skin → by nonabsorbable sutures.

**IV. Treatment of complications & other associated injuries**

- If there is liability to infection → closure is done of one layer with loose sutures
- When there is scalp defect, a rotational flap is performed.

## Hematoma

- ▶ **Types:** subcutaneous, subgaleal, cephalhematoma
- ▶ **Comp.:** as trauma, infection +  
cephalhematoma → jaundice, anemia
- ▶ **Invest.:** as trauma esp. X-ray
- ▶ **TTT:** cold foment, antibiotics, aspiration or evacuation

|                    | Subcutaneous                                                                              | Subgaleal<br>(subaponeurotic)                                                                                                                                                                | Cephalhematoma                                                                                                                     |
|--------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Site               | Under the skin<br>(Confined to dense subcutaneous layer) Localized to the site of trauma. | Under galea aponeurotica in loose areolar tissue.                                                                                                                                            | Under the periosteum                                                                                                               |
| Trauma             | Direct trauma                                                                             | Scalp trauma                                                                                                                                                                                 | Birth injury                                                                                                                       |
| Source of bleeding | Scalp                                                                                     | Scalp or fractured underlying bone                                                                                                                                                           | Fractured underlying bone                                                                                                          |
| Characters         | Small, painful                                                                            | Diffuse soft, fluctuating extending as far as the attachment of the galea, reaching anteriorly to the supraorbital ridges, Posteriorly to superior nuchal line & laterally to temporal crest | It is <b>limited by suture line</b> of affected bone as the periosteum is attached at the suture lines (usually the parietal bone) |
| Scalp              | Moves with the scalp over the skull                                                       | The scalp floats over the swelling                                                                                                                                                           | The scalp moves over the swelling but the swelling can not be moved over the skull                                                 |
| DD                 |                                                                                           | Subgaleal collections: CSF(meningocele), empyema                                                                                                                                             | Depressed skull fracture.                                                                                                          |

## Complications

Infection.

Associated fracture.

Cephalhematoma → jaundice and anemia may occur.

## Investigations

Plain X-ray skull to exclude associated fracture.

## Treatment

- 1- **Cold fomentation:** immediately after trauma, to be replaced by hot fomentation later on.
- 2- **Antibiotic:** prophylaxis against secondary infection.
- 3- **In case of subaponeurotic & subpericranial Hematoma:** antibiotics +
- 4- If large (+) aspiration or surgical evacuation.
- 5- If small (+) pressure bandage.

## More details of scalp

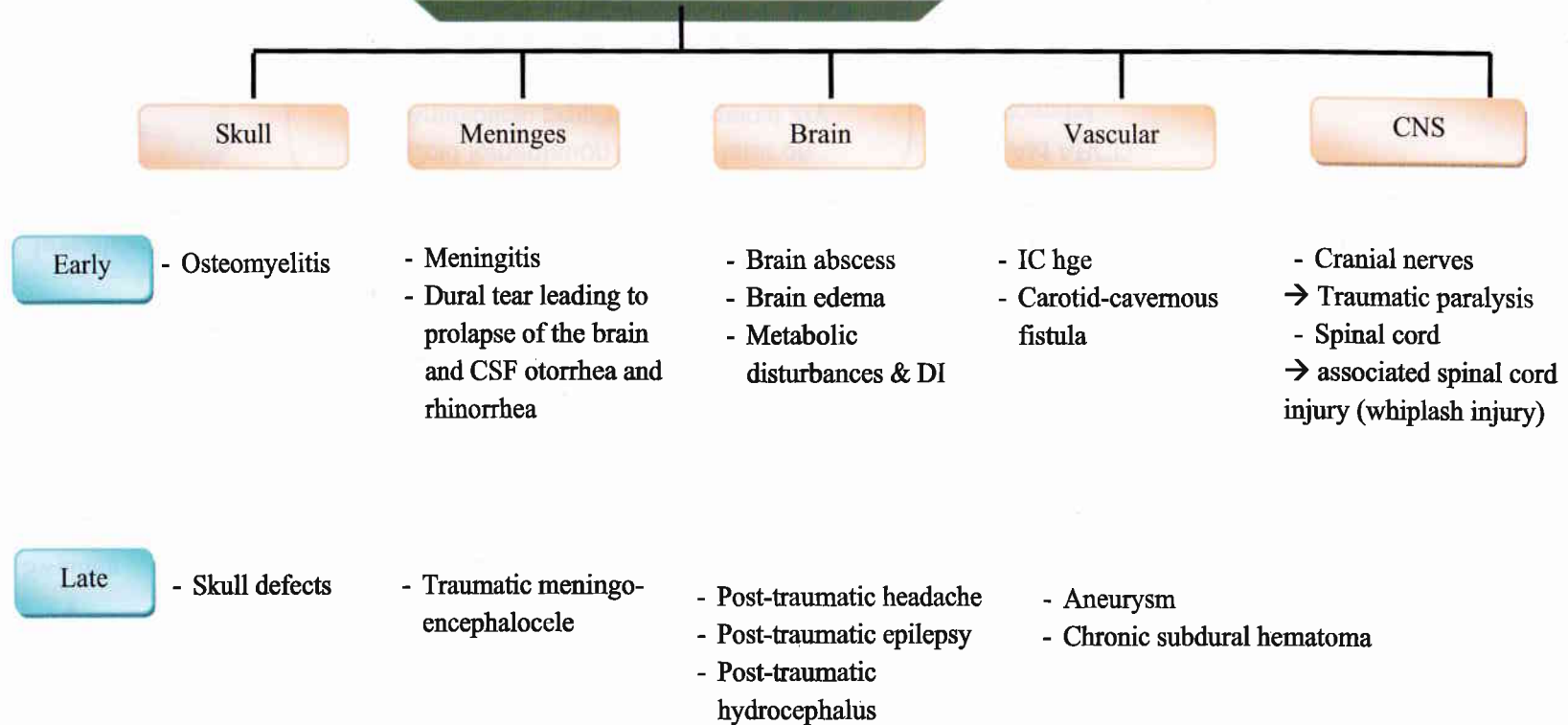
### 📌 ANATOMICAL FACTS OF SURGICAL IMPORTANCE:

1. The scalp is very rich in blood supply, thus wounds of the scalp heal rapidly without infection.
2. The arteries present in the subcutaneous layer are adherent to the fibrous tissue of this layer.  
When a vessel is injured, the muscular coat of the divided artery cannot retract readily and so bleeding is very profuse.
3. The skin, subcutaneous tissue and epicranial aponeurosis are firmly attached to each other, but they are loosely connected to the pericranium by a layer of loose areolar tissue.
4. The layer of loose areolar tissue allows accumulation of large amounts of blood or inflammatory exudate.
5. Complete avulsion of the scalp can occur.

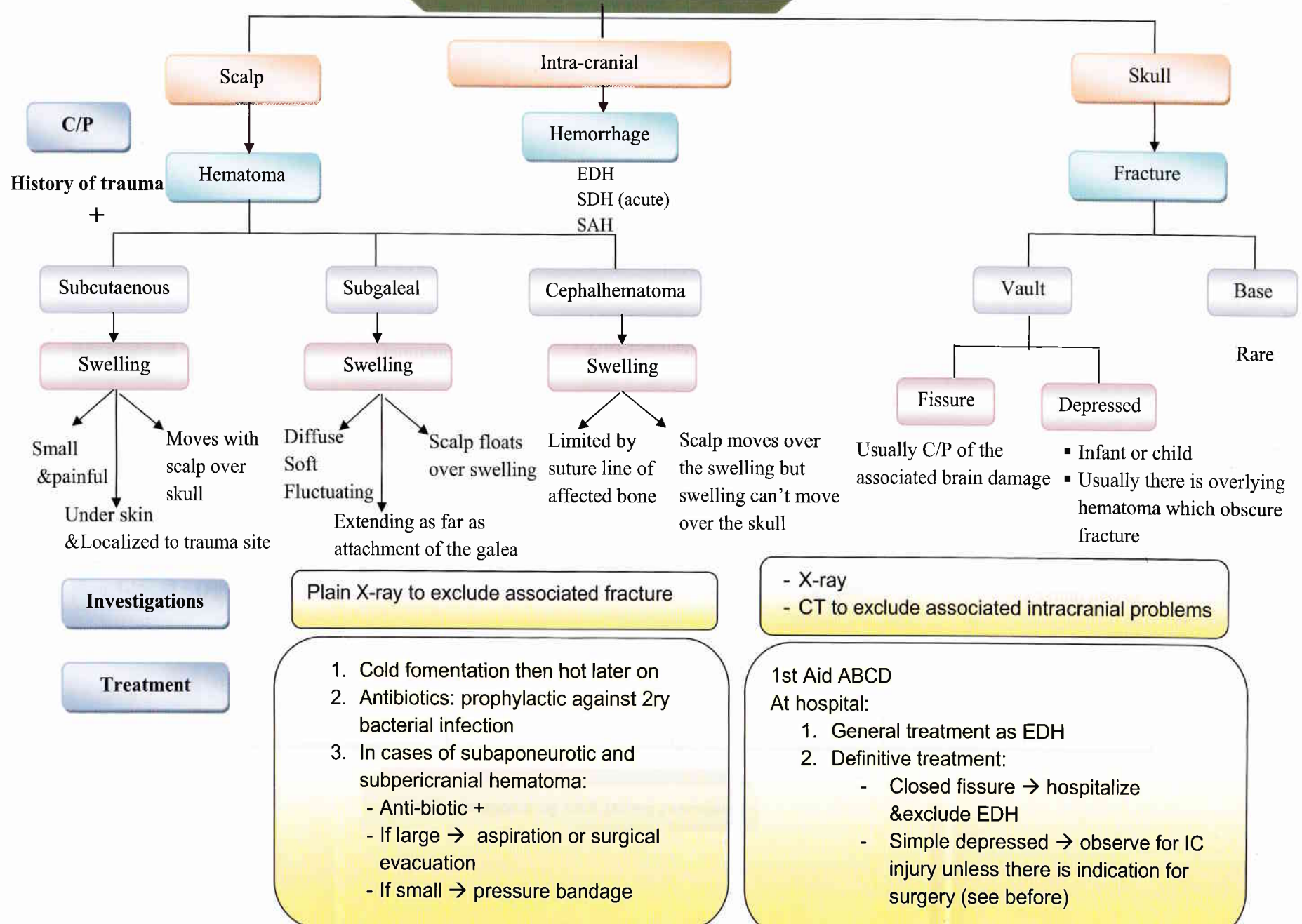
### 📌 HOW TO STOP BLEEDING FROM A SCALP WOUND?

1. **Direct pressure:** A depressed fracture should be excluded before applying direct pressure.
2. Applying multiple Allis forceps to the edge of the wound and bending them.
3. Applying multiple artery forceps to the galea aponeurotica and allowing them to fall back over the skin edge.
4. All these measures are temporary before suture of the wound.

## Complications of any head trauma



# Management of acute Head injury





# Peripheral Nerve Injury

## Introduction

- ✿ A nerve trunk is formed of collection of nerve fibers arranged in bundles bound together by connective tissue.
  - The whole nerve trunk is surrounded by a connective tissue fascia called **epineurium**.
  - Each bundle of nerve fibres is surrounded by connective tissue called **perineurium**.
  - The connective tissue around individual nerve fibers is called **endoneurium**.
  - Each nerve fiber consists of the central axis cylinder surrounded by **the myelin and the neurolemmal sheaths**.
- ✿ The fibers contained in a peripheral nerve may be motor, sensory, vasomotor pseudomotor.

## General Principles

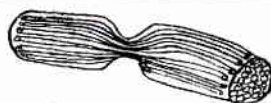
### Etiology

- **Open injury** : gunshot – stab wound.
- **Closed injury**:
  - Sudden direct violence e.g. motor car accident.
  - Ischemia.
  - fractures and dislocations.
  - Compression by tourniquets, splints, crutches or edema.
  - Traction e.g. brachial plexus injury during delivery of the fetus.
  - accidental injection of irritant substances e.g. sciatic nerve.

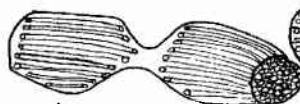
- ▶ **Etiology**: open, closed
- ▶ **C/P**: motor, sensory, autonomic, neuroma, Tinel's sign
- ▶ **Invest.**: nerve conduction velocity, EMG, sweating test
- ▶ **TTT**: conservative, surgical, orthopedic

### Pathology & Types

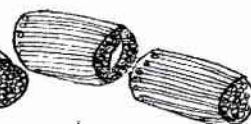
| Neuropraxia                                                                                                                                                              | Axonotmesis                                                                                                                                                                                  | Neurotmesis                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Nerve concussion: physiological interruption of all its functions without any organic damage. (functional paralysis)</li> </ul> | <ul style="list-style-type: none"> <li>- Rupture of nerve fibers but outer sheath is intact (Intracanal rupture)</li> </ul>                                                                  | <ul style="list-style-type: none"> <li>- Division of the nerve axon &amp; connective tissue (partial or complete).</li> </ul>                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>- Complete motor paralysis.</li> </ul>                                                                                            | <ul style="list-style-type: none"> <li>- Complete motor paralysis.</li> </ul>                                                                                                                | <ul style="list-style-type: none"> <li>- Complete motor paralysis.</li> </ul>                                                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>- Patchy sensory loss.</li> </ul>                                                                                                 | <ul style="list-style-type: none"> <li>- Complete sensory loss.</li> </ul>                                                                                                                   | <ul style="list-style-type: none"> <li>- Complete sensory loss.</li> </ul>                                                                                                                                                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>- No Wallerian degeneration.</li> <li>- Recovery takes place spontaneously within 4-6 weeks</li> </ul>                            | <ul style="list-style-type: none"> <li>- Wallerian degeneration in distal part for 10 days followed by regeneration 1mm/day with further 3 weeks delay before complete activation</li> </ul> | <ul style="list-style-type: none"> <li>- Wallerian degeneration occurs but regeneration is impossible.</li> <li>- After surgical repair recovery is poorest in <b>mixed nerves</b>(Ulnar &amp; median) and in <b>motor nerves</b> (a large number of small muscles) recovery is best in <b>purely motor nerves</b> (a few groups of large muscles) such as the radial nerve</li> </ul> |



Neuropraxia



Axonotmesis



Neurotmesis

## Clinical Picture

### 1- Motor manifestations:

- Loss of voluntary movement.
- Loss of reflexes (superficial & deep).
- Muscle wasting & deformity.

### 2- Sensory manifestations:

- **Superficial sensory loss:** in area of skin supplied by the affected nerve in area less than anatomical nerve distribution due to dermatomal overlap.
- Deep sensory loss.
- **Causalgia:** severe burning pain due to partial injury of median, sciatic nerve.

### 3- Autonomic manifestations:

#### - Vasomotor manifestations:

- o Early: the denervated area becomes red & warm due to sympathetic paralysis.
- o Late: the denervated area becomes pale & cold due to ↑ sensitivity of receptors to circulating catecholamines.

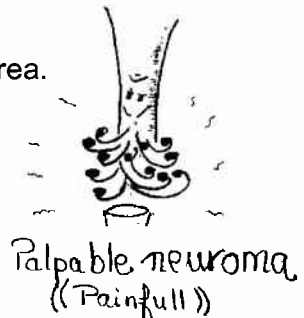
#### - Pseudomotor manifestations:

- o Loss of sweating (anhidrosis) in the denervated area.

#### - Trophic changes:

Due to disuse, sensory loss & vascular changes.

- o Skin: thin, smooth, loss of hair, neurotrophic ulcer.
- o Nails: brittle.
- o Bones: progressive decalcification which is most marked in the proximal and distal extremities of the phalanges.
- o Joints: Contracture and ankylosis develop more readily in painful than in painless lesions.



### 4- Palpable neuroma:

- May be detected along the course of the affected nerve.

### 5- Tinel's sign:

- Course of the nerve is lightly percussed from below upward gives tingling sensation (when the level of regeneration is reached).

## Investigation

1- **X-ray:** may show FB, fracture or dislocation.

2- **Nerve conduction velocity (normal: 50-70 m/sec):** No abnormality detected in neuropraxia.

3- **Electromyography:** Denervated muscles show spontaneous fibrillations after 2-4 weeks.

### 4- Sweating test:

- Dust the skin with Quinizarin powder.
- Give aspirin & coffee to induce sweating.
- Results:
  - o Sweating: change the color of the powder into deep purple.
  - o Area of anhidrosis: No change.

## Treatment

### 1- Conservative treatment:

#### - Indications:

➔ Closed injury, as it is:

- Usually Neuropraxia or axonotmesis.
- Rarely Neurotmesis.

- **Methods:**

- Splintage: prevents over stretch of the paralyzed muscles.
- Active & passive exercises & massage : maintain nutrition of tissues.
- Electrotherapy
- Protection of the skin. The patient should be warned of the susceptibility of the anaesthetic skin to injury and heat.

## 2- **Surgical treatments:**

- **Indications:**

1. Neurotmesis.
2. Open injuries.
3. Closed injuries with failure of recovery in the expected time.
4. No improvement guided by Tinel's sign
5. Palpable neuroma.

- **Methods:**

○ **Primary suture:**

- ⇒ Immediate suture.
- ⇒ Indication: Clean incised wounds.
- ⇒ Disadvantages:

The nerve sheath is very thin → difficult to hold sutures so it needs expert neurosurgeon but gives the best results.

○ **Secondary suture:** done in contaminated or lacerated wounds

- ⇒ Suture the nerve 3 - 4 weeks after injury due to end of wallerian degeneration & end of traumatic swelling & edema.

⇒ At the time of wound repair:

The 2 ends of the nerve is approximated with a black silk suture.

⇒ 3-4 weeks later:

- The 2 cut ends of the nerve are exposed carefully trimmed with a sharp knife until the healthy nerve bundles are exposed.
- Apposition is obtained by fine silk sutures picking up the nerve sheath only.
- Two methods of repair : epineurial repair, Interfascicular repair

○ **If gap is present:**

- ⇒ Neurolysis: dissection of the nerve from the surrounding structures.
- ⇒ Division of unimportant branches.
- ⇒ Transposition of the nerve to shorten its course.
- ⇒ Nerve grafting:

- Using a cutaneous nerve such as the saphenous nerve.
- This nerve is divided into segments that match the size of the defect. This type of multiple nerve grafts (2-4) bridging the defect looks like a cable hence the name "cable grafting".
- For successful take of the cable graft, a well vascularized bed should be available

- ⇒ The limb is fixed in plaster cast for 3 weeks in a position, which prevents tension on the sutured nerve.

## 3- **Orthopedic measures:**

- **Indication:**

- To improve function if recovery of the nerve is impossible.

- **Methods:**

- Arthrodesis.
- Tendon transplantation.
- Amputation: in severe multiple neuropathic ulcers

### Prognosis

- The result of nerve is better in pure motor nerve controlling the coarse movement e.g. radial & is worst in mixed nerve e.g. ulnar & median.

## More details

### Factors affecting success of surgery

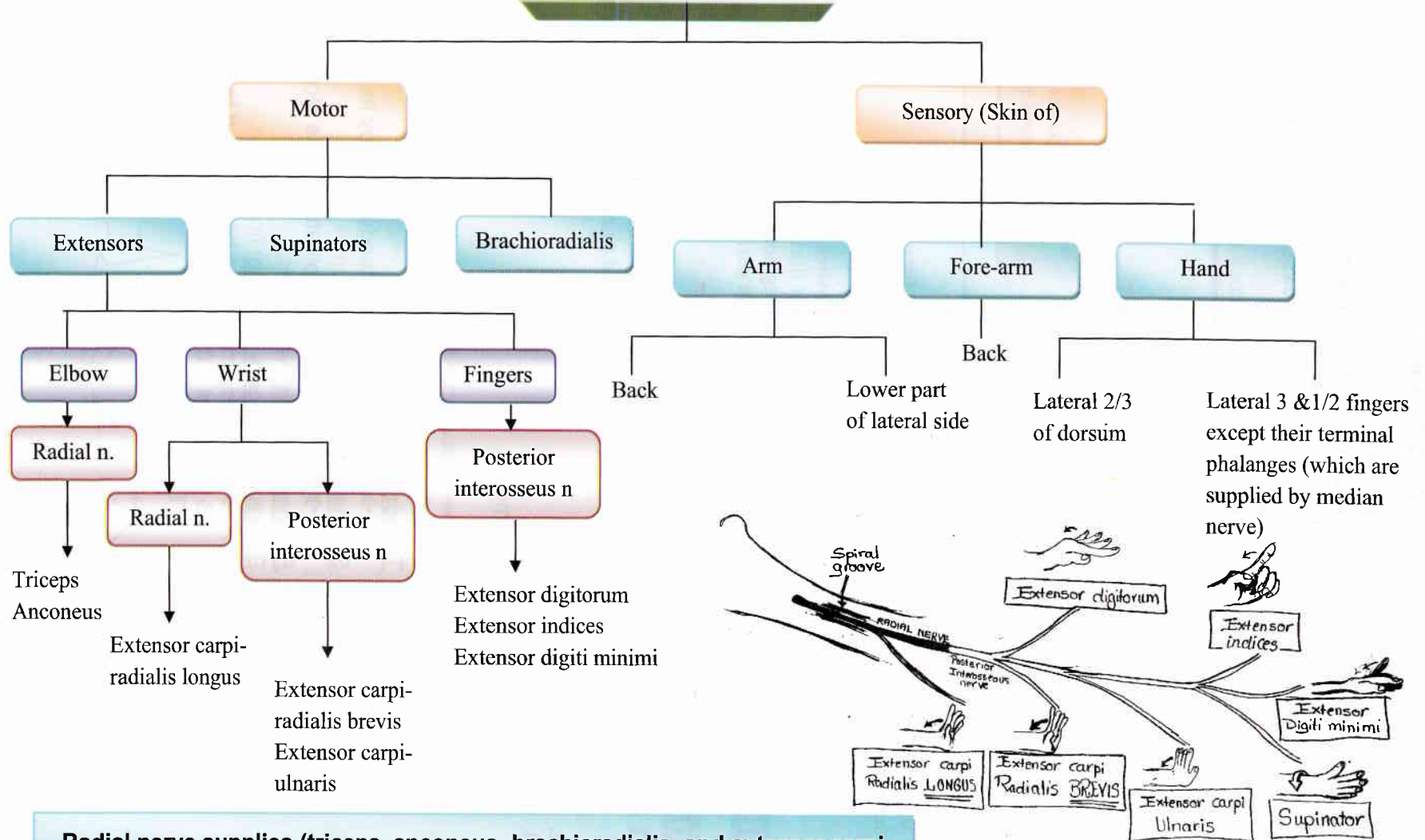
- 1. The injured nerve:** The radial nerve is by far the most satisfactory because it contains a predominance of motor fibres and there is less chance of maldistribution of the fibers during regeneration.
- 2. Level of suture:** With a high-level injury the length of time taken by the regenerating fibers to reach the more distal muscles reduces the chance of a satisfactory recovery.
- 3. Time interval between injury and suture:**
  - The earlier the repair, the better is the results since a long period of denervation of a muscle allows more wasting and degeneration of the muscle fibers.
  - A muscle which has been deprived of its nerve supply for more than 2 years cannot be expected to show any degree of recovery owing to irreversible changes in the motor end plates.
- 4. Extent of injury.** Large gaps between cut ends have a bad prognosis.
- 5. Age and general condition of the patient.** The results of nerve suture are particularly good in children and adolescents.



# Radial Nerve Injuries

## Anatomical considerations

### Radial nerve supplies

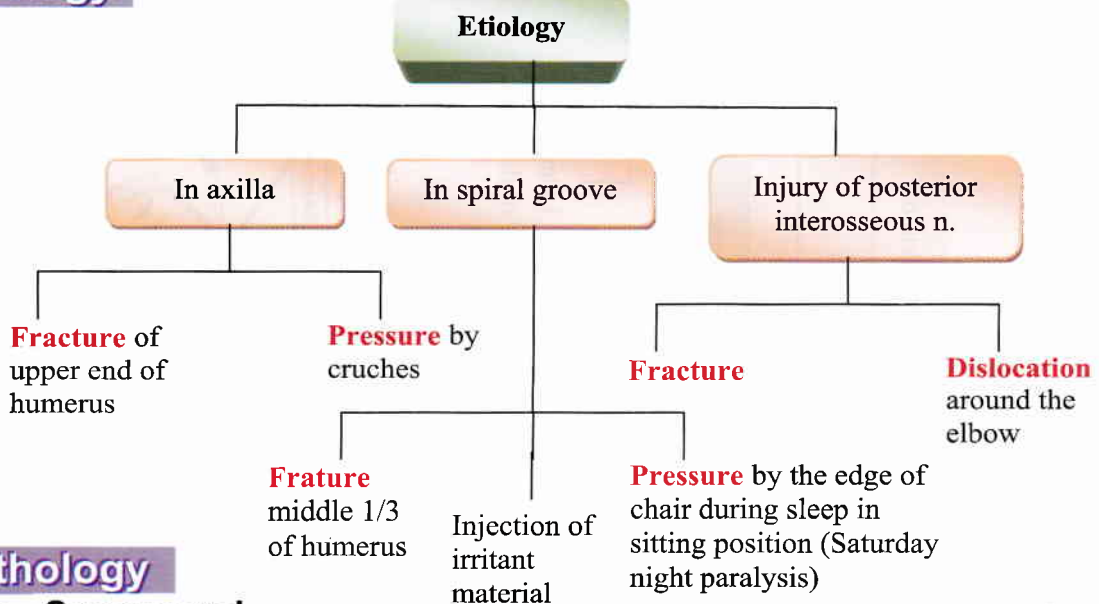


**Radial nerve supplies (triceps, anconeus, brachioradialis, and extensor carpi radialis longus) while the post. Interosseus nerve supplies the others.**

Motor supply of Radial nerve

**Roots of origin**C<sub>5</sub>, 6, 7, 8 & T<sub>1</sub>**Etiology**

- ▶ **Etiology:** fracture/dislocation, pressure, injection
- ▶ **C/P:** - **Axilla:** flexed elbow, wrist & finger drop
- **Spiral groove:** wrist & finger drop
- **Post. interosseous n.:** finger drop
- ▶ **Invest.:** as before
- ▶ **TTT:** as before + cock up splint

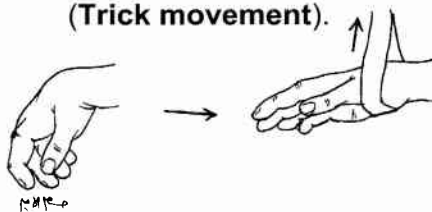
**Pathology**

- See general.

**Clinical Picture****I- In axilla (flexed elbow + wrist drop + finger drop):**

1. History of trauma (may be absent in Saturday night paralysis or fracture upper end humerus).
2. Associated injuries.
3. Motor manifestations:
  - Loss of voluntary movements.
  - Loss of reflexes.
  - Deformity (flexed elbow + wrist drop + finger drop) due to paralysis of the following muscles:

- Triceps : flexed elbow.  
→ However can be extended only by its own weight.
- Supinators : pronated forearm.  
→ However can be supinated by the biceps.
- Extensors of wrist: wrist drop.
- Extensors of fingers & thumb: finger drop.  
→ However, fingers can be extended by the lumbricals & interossei if the wrist & fingers are supported. (Trick movement).



4. Sensory manifestations:
  - Sensory loss is limited to a small area at the base of the thumb due to overlap of sensory supply by nearby nerves.
5. Autonomic manifestations (see general).
  - Vasomotor.
  - Pseudomotor.
  - Trophic changes.
6. Palpable neuroma.
7. Tinel's sign.
8. Others: scar, swelling (mal-united fracture or callus).

## II- In spiral groove (wrist drop + finger drop):

- As before, but extension of the elbow is intact as long head of triceps receives its nerve supply high up in the axilla.

## III- Injury of the posterior interosseus nerve (finger drop):

- Only finger drop because: Extensor carpi radialis longus is intact so extension of wrist is normal (nerve supply from radial nerve not posterior interosseus).

## Investigations

See general

## Treatment

### 1- Conservative treatment:

- **Indications:**
  - Closed injury.
- **Methods:**
  - **Splintage:** prevent over stretch of the paralyzed muscles. **The hand is hyperextended in a cock up splint to prevent stretching of the paralyzed muscles.**
  - Active & passive exercises & massage : maintain nutrition of tissues.

### 2- Surgical treatments:

- **Indications:**
  1. Neurotmesis.
  2. Open injuries.
  3. Closed injuries with failure of recovery in the expected time.
  4. No improvement guided by Tinel's sign.
  5. Palpable neuroma.
- **Methods:**
  - **Primary suture:**
    - ⇒ Immediate suture.
    - ⇒ Indication: Injuries occur during operation.
    - ⇒ Disadvantages:

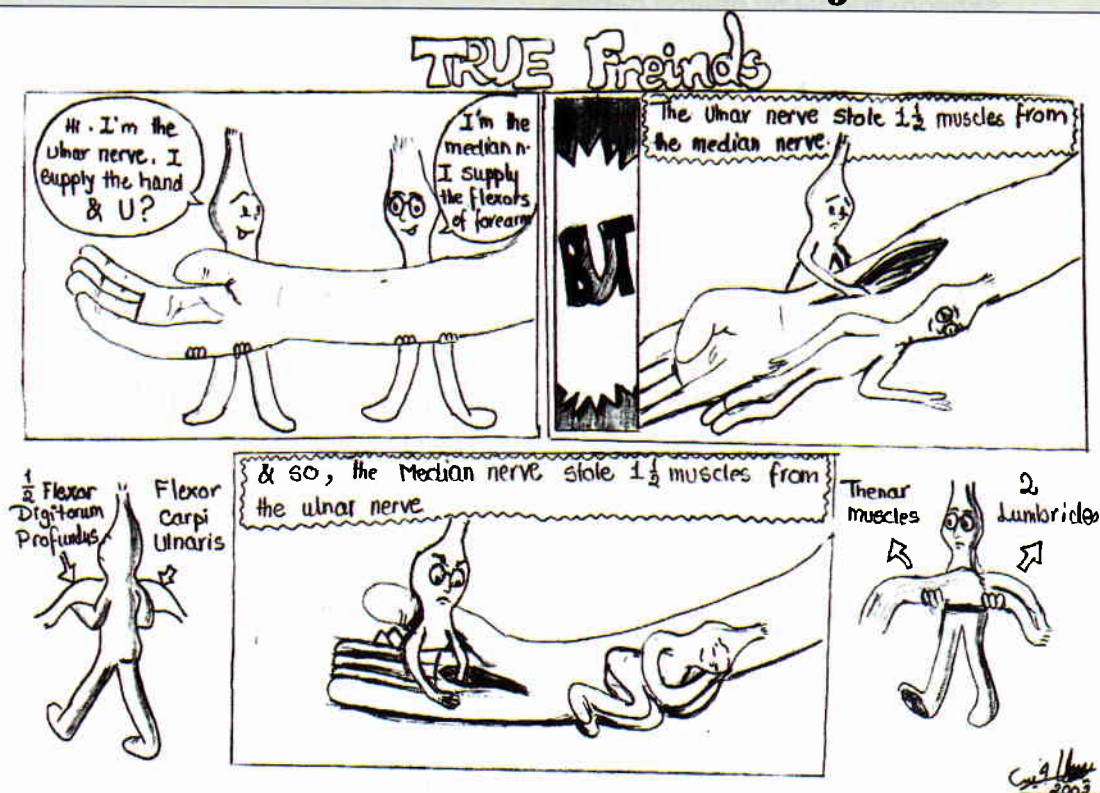
The nerve sheath is very thin → difficult to hold sutures so it needs expert neurosurgeon.
  - **Secondary suture:** (see general principles)
  - **If gap is present:** (see general principles)

### 3- Orthopedic measures: (see general principles)

## Prognosis

- Good (purely motor nerve controlling coarse movements).
- recovery may be expected in 9-12 months.

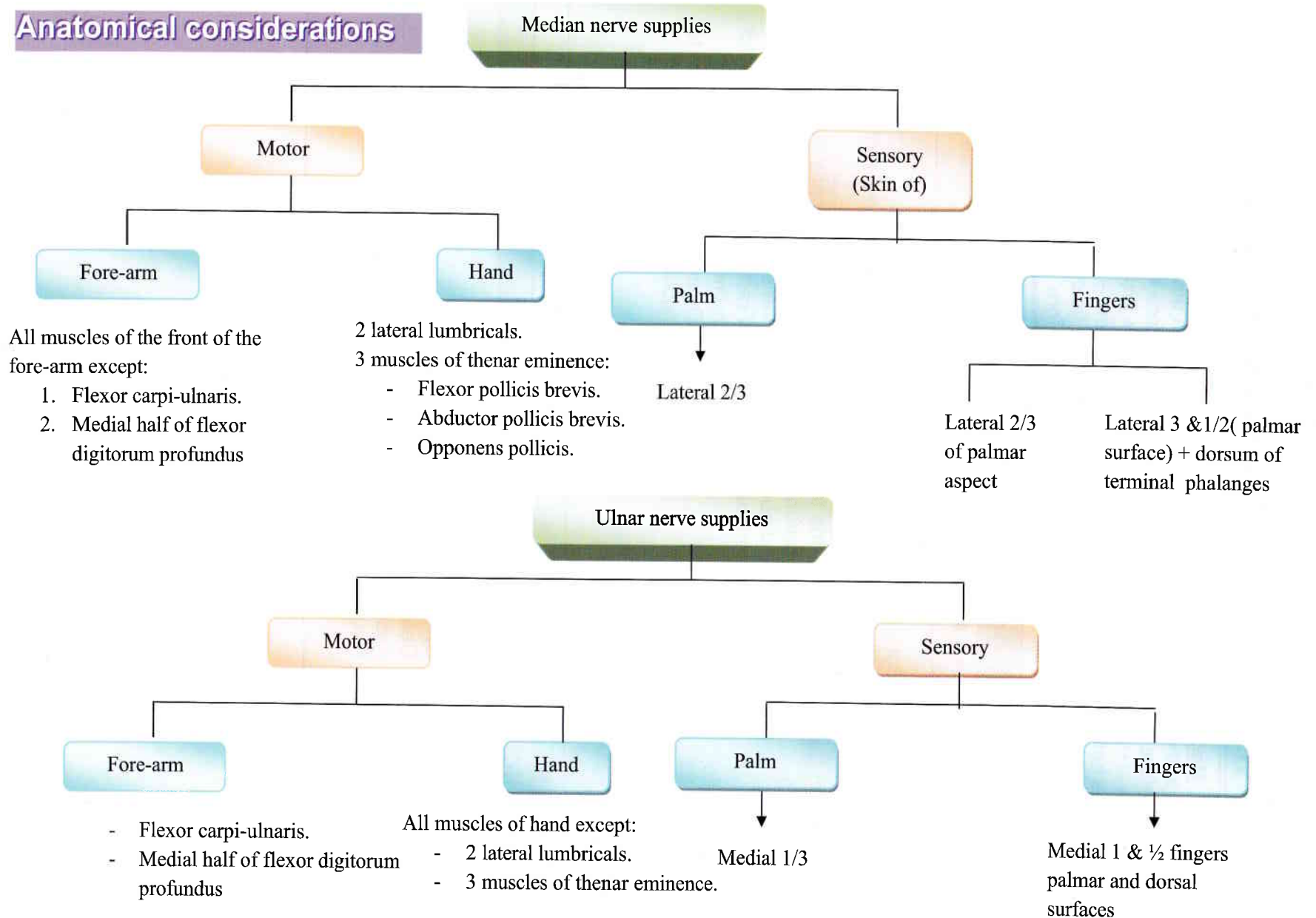
# Median & Ulnar Nerve Injuries



The 4 lumbricals and 8 interossei are attached to extensor expansion so paralysis of lumbricals alone or interossei alone do not produce clawing, but paralysis of both  
 → weakness of extensor expansion → flexion deformity by flexor digitorum superficialis and profundus



## Anatomical considerations



## Median & Ulnar nerve Injuries

### Median n. injury

- ▶ **Etiology:** at the wrist, in the forearm
- ▶ **C/P:** as before + at wrist → ape hand  
At elbow → +ve Ochsner's clasping test
- ▶ **Invest.:** as before
- ▶ **TTT:** as before

### Ulnar n. injury

- ▶ **Etiology:** at the wrist, in the forearm
- ▶ **C/P:** as before + at wrist → partial claw hand + Froment's test  
At elbow → ulnar paradox
- ▶ **Invest.:** as before
- ▶ **TTT:** as before

|                          | Median N. Injury                                                                                                                                                                        | Ulnar N. Injury                                                                                                                                                                                                                               |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Roots                    | C5, 6, 7, 8 & T1                                                                                                                                                                        | C7, 8 & T1                                                                                                                                                                                                                                    |
| Etiology                 |                                                                                                                                                                                         |                                                                                                                                                                                                                                               |
| A. Injury at the wrist:  | <ul style="list-style-type: none"><li>- Cut wound.</li><li>- Colle's fracture.</li><li>- Carpal tunnel \$.</li></ul>                                                                    | <ul style="list-style-type: none"><li>- Cut wound.</li><li>- Fracture lower end of ulna.</li></ul>                                                                                                                                            |
| B. Injury in the forearm | <ul style="list-style-type: none"><li>- Uncommon, due to fractures &amp; dislocations around elbow.</li><li>- May be injured above the elbow by tourniquet.</li></ul>                   | <ul style="list-style-type: none"><li>- Immediate injury due to fractures &amp; dislocations around the elbow.</li><li>- Fracture medial epicondyle of humerus.</li><li>- Delayed ulnar neuritis (due to cubitus valgus deformity).</li></ul> |
| Pathology                | See general                                                                                                                                                                             |                                                                                                                                                                                                                                               |
| Clinical Picture         |                                                                                                                                                                                         |                                                                                                                                                                                                                                               |
| Symptoms:                | <ol style="list-style-type: none"><li>1. History of trauma.</li><li>2. Pain.</li><li>3. Swelling.</li><li>4. Deformity.</li><li>5. Associated injuries.</li><li>6. Causalgia.</li></ol> |                                                                                                                                                                                                                                               |

**Signs:**  
**1. Motor**

## Median N. Injury

### Injury at the wrist

1. Injury of thenar muscles:  
(wasting of thenar eminence)



a. Opponens pollicis muscle:

- Result in → Ape hand deformity (Simian hand).

(Thumb in same plane as other fingers adducted with loss of opposition due to paralysis of Thenar muscles except adductor pollicis).



- Tested by: counting finger test "loss of opposition of the thumb)



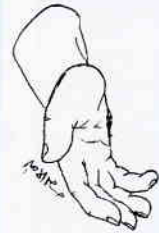
b. Flexor pollicis brevis & abductor pollicis brevis:

- Result in: weakness of abduction & flexion of the thumb.
- Tested by: pin touch test

2. Injury of 2 lateral lumbricals

## Ulnar N. Injury

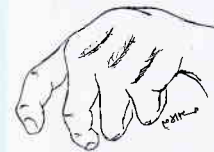
- 1- Injury of hypothenar muscles: (wasting)



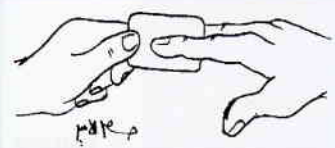
- Result in: loss of abduction of little finger.

2- Injury of interossei:

- Result in: guttering, No fanning, No adduction



- Tested by: card test  
Loss of abduction & adduction due to paralysis of interossei.



3- Injury of 2 medial lumbricals

- Result in: **Partial claw hand** due to paralysis of the medial 2 lumbricals with intact lateral 2 lumbricals because they are supplied by median nerve (extension of MPJ and flexion of IPJ of medial 2 fingers)..



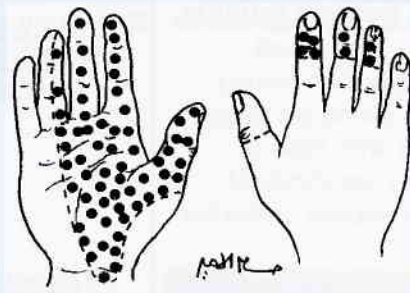
4- Injury of adductor pollicis:

- Result in: loss of adduction of thumb.

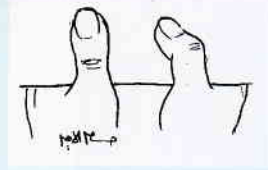
**2. Sensory**

■ Sensory loss over:

- Lateral 2/3 of palmar surface .
- Lateral 3 & 1/2 fingers.
- Dorsum of their terminal phalanges.

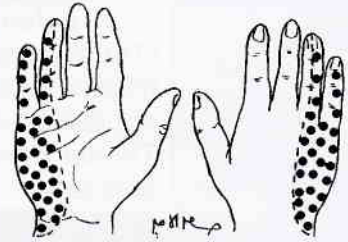


■ Tested by: **Froment's test:**  
Weak adduction of the thumb due paralysis of adductor polices.



■ Sensory loss over:

- medial 1 & 1/2 fingers .
  - medial 1/3 of the palm.
- ➔ No affection of dorsal aspect of (due to sparing of dorsal cutaneous branch which passes backward 6 cm. above wrist).



**3. Autonomic**

**4. Palpable neuroma**

**5. Tinel's sign**

See general

**Injury at the elbow**

As above +

**1. Motor**

■ **Injury of:**

- a) **Flexor carpi radialis:**  
Weak flexion of wrist & ulnar deviation.



- b) Lateral 1/2 of flexor digitorum profundus:  
+ve Ochsner's Clasp test  
(pointing index finger)



- c) a + b  
Wasting of the lateral aspect of the forearm

■ **Injury of:**

- a) **Flexor carpi ulnaris:**  
- Loss of ulnar deviation or radial deviation of the flexed wrist.
- b) **Medial 1/2 of flexor digitorum profundus:**  
- loss of flexion of terminal phalanx of little & ring finger (ulnar paradox).



|                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                     | <p>d) <i>Flexors of the forearm:</i><br/>Weak hand grip &amp; weak flexion</p> <p>e) <i>Flexor pollicis longus:</i><br/>The patient is unable to flex the terminal phalanx of the thumb.</p> <p>f) <i>There is paralysis of the 2 pronators with loss of pronation of the forearm.</i></p> |                                                                                                                                                                                                                             |
|                                                                                                                     | <b>Injury in axilla &amp; arm</b>                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |
| <p><b>2. Sensory</b></p> <p><b>3. Autonomic</b></p> <p><b>4. Palpable neuroma</b></p> <p><b>5. Tinel's sign</b></p> | <p>a. <i>Ape hand</i></p> <p>b. <i>Hypoesthesia of median distribution in hand</i></p> <p>c. <i>Weakness of forearm flexion &amp; pronation</i></p> <p>d. <i>Weakness of wrist &amp; finger flexion with ulnar deviation</i></p>                                                           | <p>a. <i>Partial claw hand</i></p> <p>b. <i>Hypoesthesia in hand with ulnar distribution</i></p> <p>c. <i>Weakness of intrinsic muscles of hand</i></p> <p>d. <i>+ve Froment's sign</i></p> <p>e. <i>+ve paper test</i></p> |
| <b>Investigations &amp; TTT</b>                                                                                     | <p><b>As above</b></p> <p><b>See general</b></p>                                                                                                                                                                                                                                           |                                                                                                                                                                                                                             |

**DD (of claw hand)**

1. Klumpke's palsy & costo-clavicular \$.
2. **Combined ulnar & median n. injury.**
3. Volkmann's ischemic contracture.
4. Dupuytren's contracture.
5. Post-burn scar contracture.

# Sciatic Nerve Injury

## Etiology

1. Penetrating wounds of gluteal region.
2. Post. hip dislocation.
3. Fracture pelvis.
4. IM injection.

- **Etiology:** post. hip dislocation, IM injection  
 ► **C/P:** drop foot, clawing of toes, anesthesia below the knee except medial aspect

## Pathology

See general

## Clinical picture

### 1- Motor:

- Paralysis of hamstrings → weak flexion of the knee (some degree of flexion is preserved by sartorius & gracilis.)
- Paralysis of all leg muscles → **foot drop**.
- Paralysis of intrinsic muscles of foot → clawing of toes.

### 2- Sensory:

- Anaesthesia below knee except on the medial side of leg, foot & big toe → supplied by saphenous n. (branch of femoral n.).

### 3- Autonomic manifestations.

### 4- Palpable neuroma.

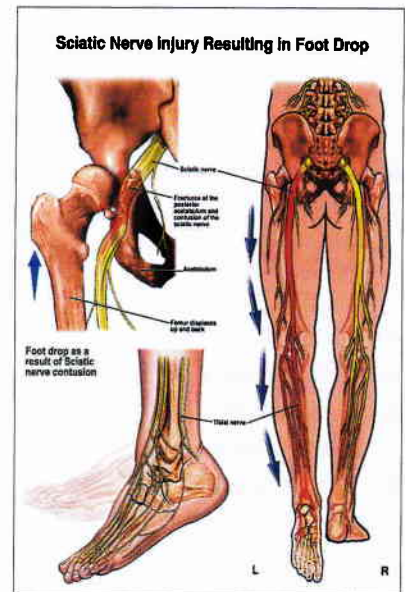
### 5- Tinel's sign.

## Investigation

- See general

## Treatment

- See general but ....
- **Conservative**
  - The deformity is controlled by wearing a suitable support to prevent foot drop
  - The nutrition of the muscles is maintained by massage and electrotherapy.



### Causes of foot drop:

- Sciatic nerve injury.
- Lumbar disc prolapse.
- Fracture neck fibula.
- Peripheral neuropathy.
- Parasagittal meningioma.

# Lateral Popliteal Nerve Injury

## Etiology

- Injury is common in its most superficial part, which present around the neck of fibula.
- Injury is usually due to **fracture neck of fibula**.
- Deep wounds of the thigh.
- Subcutaneous tenotomy of the biceps tendon.
- Pressure by strapping, bandages, splints and plasters.

- ▶ **Etiology:** fracture neck fibula
- ▶ **C/P:** *early:* foot drop  
*Late:* paralytic talipes equinovarus
- ▶ Good prognosis, mainly motor"

## Pathology

➔ See general principles.

## Clinical picture

### 1- Motor

- Paralysis of the dorsiflexors → plantar flexion i.e. **foot drop**.(early)
- Paralysis of the elevators of the foot → inversion.  
→ **Paralytic talipes equinovarus**.(late)

### 2- Sensory:

- Anaesthesia over the lateral part of the dorsum of foot & part of the lateral side of the leg.

### 3- Autonomic manifestations.

### 4- Palpable neuroma.

### 5- Tinel's sign.

## Investigation

➔ See general principles.

## Treatment

➔ See general principles.

## Prognosis

→ Good (mostly motor).

# Medial Popliteal Nerve Injury

### 1- Motor:

- Paralysis of plantar flexors → dorsiflexion & **calcaneovalgus**.
- Paralysis of muscles of the sole → clawing of the toes.

### 2- Sensory: → anaesthesia of the sole.

# Brachial Plexus Injuries

## Etiology

### a. Open injuries

- Gunshot, stabs in the lower part of the post. triangle (rare)

### b. Traction injuries

- heavy weights fall on the shoulder → undue traction upon the roots of the plexus, especially of the fifth and sixth nerves.
- Hyperabduction of the arm
- Birth injury → *vertex or breech presentation*

### c. Pressure injuries

- Fractures of the clavicle and dislocations of the shoulder
- Attempts to reduce them may result in injury to the plexus, especially to the medial cord.

- ▶ **Etiology:** open, traction, pressure injuries
- ▶ **C/P:** - Complete: paralyzed UL except trapezius + anaesthetic UL except skin over deltoid & medial side of the arm + Horner's \$
- Upper trunk: policeman's tip deformity
- Lower trunk: klumpke's paralysis
- ▶ **Invest.& TTT:** as before

## Pathology

- See general

## Clinical Picture

### A. Complete brachial plexus injuries: damage of all roots.

- **Motor changes:** affecting all muscles of the upper limb except trapezius.
- **Sensory changes:** Anaesthesia of whole upper limb except:
  - Medial side of arm (supplied by intercosto-brachial nerve (T2)).
  - Skin over upper part of deltoid muscle (supplied by supraclavicular nerve (C4)).
- **Horner's syndrome:** due to sympathetic paralysis.

### B. Upper trunk injury: (C5 - C 6) Erb-Duchenne paralysis

- **Motor changes:** policeman's tip deformity.(waiter's tip position)

- If the sixth nerve escapes the arm will be internally rotated by the unopposed subscapularis

- **Sensory changes:** Anaesthesia over the deltoid muscle (except upper part).

- Sensory changes are absent if the fifth nerve only is involved

### C. Lower trunk injury: (C8 - T1) Klumpke's paralysis.

- **Motor changes:** complete claw hand.
- **Sensory changes:** anaesthesia along the medial aspect of the forearm & the medial 3&1/2 fingers.
- **Horner's syndrome:** due to sympathetic paralysis.(it indicates bad prognosis)



## Investigations

- ➡ See general principles.



## Treatment

### 1- Conservative treatment:

- **Indications:**
  - ▣ **Closed injury:**
    - Usually Neuropraxia or axonotmesis.
    - Rarely Neurotmesis.
- **Methods:**
  - **Splintage:** The arm is splinted in right-angled abduction to relax the deltoid and supra and infra spinatus, the forearm being flexed and supinated to relax the biceps, brachialis and supinators.
  - **Active & passive exercises & massage:** maintain nutrition of tissues.
  - **Electrotherapy**

### 2- Surgical treatments:

- **Indications:**
  1. Neurotmesis.
  2. Open injuries.
  3. Closed injuries with failure of recovery in the expected time.(2 months)
- **Methods:**
  - **Primary suture**
    - ➡ See general principles.
  - **Secondary suture**
    - ➡ See general principles.

### 3- Orthopedic measures:

- ➡ See general principles.

## Prognosis

- The operation is difficult and the results are often disappointing.
- In closed injuries the lesion is usually a mixed one due to a combination of neuropraxia, axonotmesis and neurotmesis and so conservative treatment is often followed by progressive improvement.

## Axillary nerve injury

### Etiology

This nerve is occasionally injured where it winds around the neck of the humerus by:

1. Gunshot wounds.
2. Direct blows on the shoulder.
3. Fractures of the surgical neck of the humerus.
4. Dislocations of the shoulder.
5. Crutch palsy.

- ▶ Injury at neck of humerus
- ▶ flat shoulder

### Pathology

- ➡ See general principles.

### Clinical Picture

- History of trauma.
- Motor loss.
  - The deltoid muscle is paralyzed and wastes rapidly so that the shoulder is flattened. The patient is unable to raise the arm from the side
- Sensory loss.
  - there may be temporary anaesthesia over the posterior fold of the axilla.
- Trophic changes.

**Investigation**

- ▶ See general principles.

**Treatment**

- ▶ See general principles.

**Scheme for written questions of peripheral nerves****Etiology**

- Open injury
- Closed Injury

**Pathology**

- Neuropraxia.
- Axonotmesis.
- Neurotmesis.

**Clinical picture**

- History of trauma.
- Motor loss.
- Deformity.
- Sensory loss.
- Trophic changes.
- Special tests.
- Special types of pain e.g. causalgia.

**Investigations**

- EMG.
- NCV.

**Treatment**

- Closed nerve injury.
- Opened nerve injury.

In modern surgery the best response is immediate nerve repair using microsurgical repair provided that wound is not heavily contaminated or lacerated.

**Prognosis**

# Carpal Tunnel Syndrome

## Anatomical considerations

### Site

- Thick band stretches distal to wrist joint (hand structure).

### Attachments

- Medially** → attached to pisiform & hook of hamate bones
- Laterally** → tubercle of scaphoid & crest of trapezium

### Superficially From medial to lateral

1. Ulnar nerve
2. Ulnar vessels
3. Palmar cutaneous branch of ulnar nerve
4. Tendon of palmaris longus muscle
5. Palmar cutaneous branch of median nerve

*N.B: Radial artery does not pass superficial to flexor retinaculum*

### Deep to it

#### The carpal tunnel containing

1. Flexor digitorum superficialis tendons
2. Flexor digitorum profundus tendons
3. Ulnar bursa enclosing flexor digitorum superficialis & profundus tendons (tendons of superficialis are arranged in two strata)
4. Flexor pollicis longus tendon
5. Radial bursa enclosing flexor pollicis longus tendon
6. Median nerve.
7. Flexor carpi radialis tendon & its synovial sheath (SPECIAL CANAL).

## Definition of carpal tunnel syndrome

- It is compression of the median nerve inside the carpal tunnel under the flexor retinaculum.

## Etiology

- Primary:** idiopathic.
- Secondary:** rheumatoid arthritis, myxedema, pregnancy, after Colle's fracture, fracture scaphoid, acromegaly.

## Clinical picture of chronic primary carpal tunnel syndrome

### Symptoms

- Early** → pain in the hand along the hand and lateral 3 fingers.  
→ It is worse at night and increases by full flexion of the wrist.
- Late** → weakness, parathesia & numbness.

- ▶ **Etiology:** 1ry, 2ry (R.A., myxedema, acromegaly, pregnancy)
- ▶ **C/P:** as median n. injury but no anaesthesia in palm
- ▶ **Invest.:** ↓ nerve conduction velocity
- ▶ **TTT:** division of flexor retinaculum

**Signs****As median nerve injury at the wrist.**

- **Early** → there is tenderness on percussion on the course of the median nerve under the flexor retinaculum.
- **Late** → there is atrophy of thenar muscles & sensory loss along digital branches of lateral 3 ½ fingers.

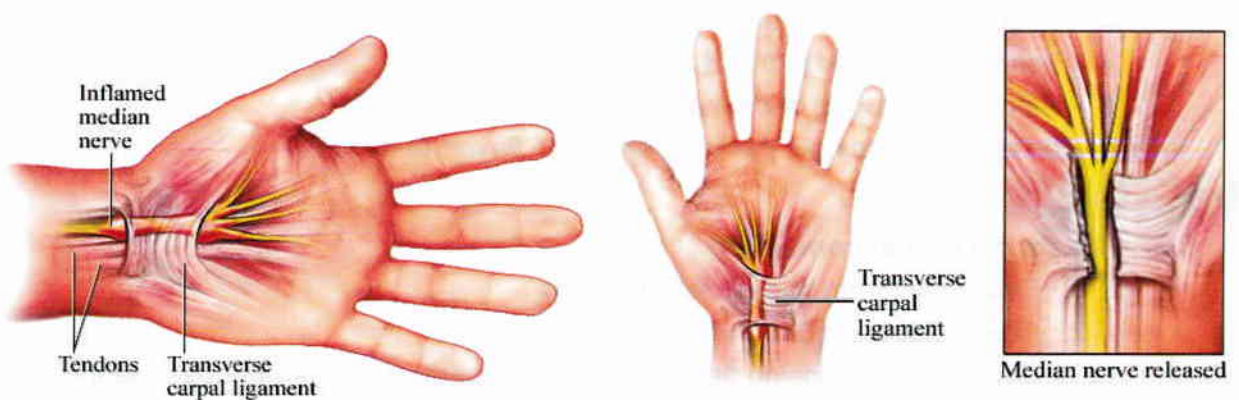
No sensory loss over palm as palmar cutaneous branch of median nerve passes superficial to flexor retinaculum.

**Investigations**

- Nerve conduction velocity: impaired

**Treatment**

- Division of the flexor retinaculum.

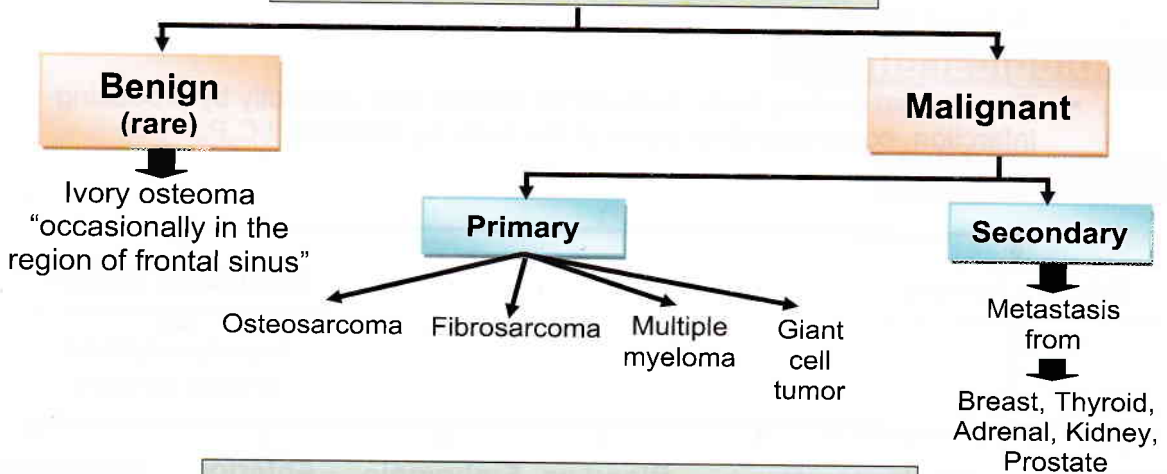




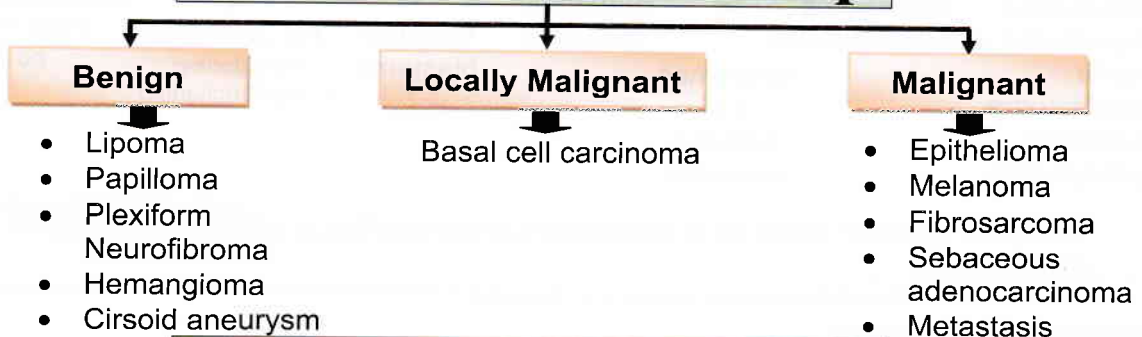
# Tumors

1. Skull tumors.
2. Tumors of the scalp.
3. Brain tumors.
4. Nerve tumors.

## 1- Skull tumors



## 2- Tumors of the scalp



## 3- Brain Tumors

### Definition

- Intracranial mass created by abnormal and/or uncontrolled cell division.

- ▶ **C/P:** ↑ ICT, false & true localizing signs
- ▶ **Invest.:** CT, MRI
- ▶ **TTT:** - *Radical:* if benign & superficial  
- *Palliative:* dehydrating measures, radio, chemo

- The term intracranial tumor is used to refer to all neoplasms arising from the skull, meninges, blood vessels, pituitary & pineal glands, cranial Ns, brain tissue as well as metastatic tumors.

### Incidence

- In adults: 1.4 % of all cancers
- In children: 20-25 % of all cancers
- More than 50% of brain tumors are secondaries

## Etiology

### Unknown

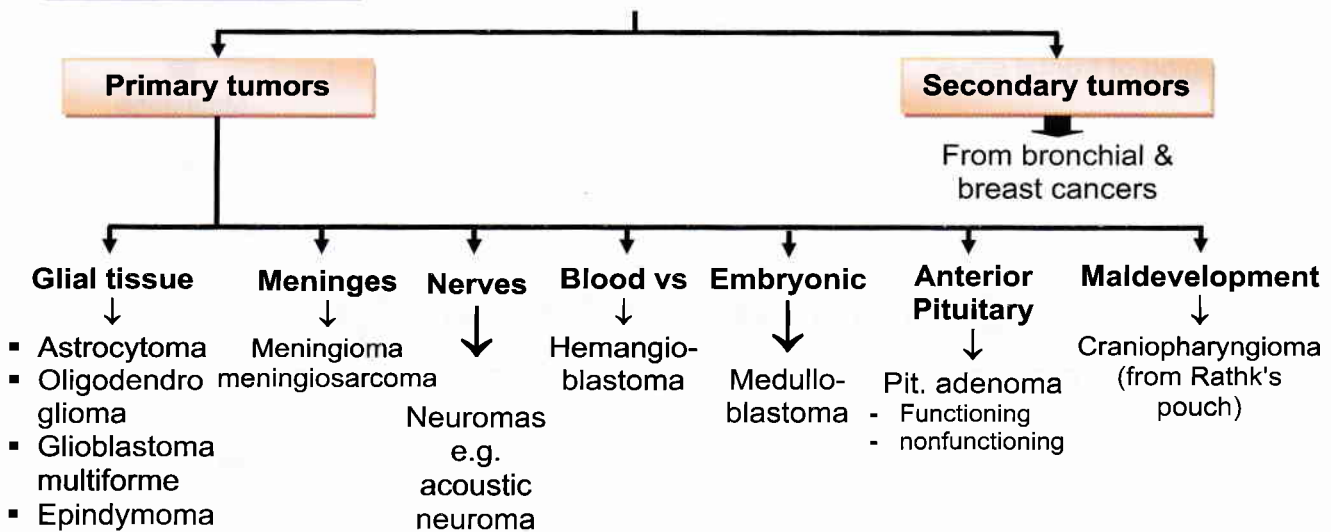
#### Risk factors include:

- 1- Exposure to radiation
- 2- Certain inherited disorders:
  - Li-Fraumeni syndrome
  - Neurofibromatosis
  - Turcot's syndrome
- 3- Hormone replacement therapy
- 4- Head injuries

## Pathological effects

- Tumors can destroy brain cells either directly &/or indirectly by producing infarction, compress other parts of the brain by increase I.C.P.

## Classification



The term "**glioma**" refers to all glial tumors in general but is also used instead of astrocytoma.

## Clinical picture

## Clinical Picture of Brain Tumors

May be asymptomatic

Increased ICT

### Headache

In about 1/3 of patients  
Due to stretch of meninges  
Dull aching  
Peak in the morning  
↑ by cough, straining, sneezing

### Vomiting

Projectile  
More frequent in the morning  
Not related to meals  
Not preceded by nausea

### Papilledema

Blurring of vision

False localizing signs  
(Due to increased ICT)

Ventricular dilatation

Lateral V. → mental confusion  
3<sup>rd</sup> V. → bitemporal hemianopia  
4<sup>th</sup> V. → vomiting, ↑BP, ↓HR

Cranial n. palsies  
(especially VI n.)

Herniation

Tentorial (uncal) herniation  
Tonsillar herniation

True localizing signs

Cerebral  
hemispheres

Frontal    Parietal    Temporal    Occipital

Cerebello-pontine angle tumors

- Ipsilateral cerebellar ataxia
- Ipsilateral affection of 5<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> N.
- Contralateral hemiparesis

Pituitary tumors

- Hormonal manifestations
- Neurological manifestations
- Increased ICT

.e.g

- Hemiplegia in tumours of the motor area.
- Aphasia in tumours of the speech area.
- Hormonal disturbances in functioning pituitary tumours (Cushing's disease, acromegaly, and galactorrhea with prolactinomas).

## Investigations

### A- CT scan: (computerized tomography of the brain) It shows:

- a. Site, size & density of the tumor & any cystic degeneration or calcification.
- b. The size of the cerebral ventricles.
- c. Any midline shift.
- d. Associated hydrocephalus
- e. Better for bony & calcified pathologies

### B- MRI: (magnetic resonance imaging): (investigation of choice)

- a. Better quality
- b. No bony artifacts
- c. Show small metastasis
- d. More prominent anatomy.

### C- Plain x-ray: of the skull which might show: (general signs of ICT)

- 1- Separation of the cranial sutures.
- 2- Beaten-silver appearance or finger prints.
- 3- Sellar changes:
  - a. Enlargement of the sella turcica.
  - b. Rarefaction and destruction of the dorsum sellae and the posterior clinoids.
  - c. Encroachment on the sphenoid air sinus
- 4- Local changes in the plain skull X-ray may occur with specific tumors, e.g.:
  - Suprasellar calcification in craniopharyngiomas.
  - Hyperostosis and skull thickening in meningiomas.
  - Widening of the skull base foramina with skull base tumors.

### D- Cerebral angiography: This may show:

- a) General signs of increased intracranial tension e.g. stretching of all the cerebral vessels.
- b) Shift of the main cerebral vessels (anterior or middle) by the tumor.
- c) Appearance of abnormal vessels feeding the tumor

## Treatment

### a- Radical surgery: mainly for benign superficial tumors

- 1- In patients shows signs of compression → urgent dehydration by 25% dextrose or mannitol + dexamethazone before surgery
- 2- In patients have hydrocephalus (common with posterior fossa tumors) → a ventriculoperitoneal shunt before surgery

- Many of the skull base tumors that were considered difficult to reach are now easily accessible by removing as much as possible of the bones of the skull base, face, and ear in order to minimize brain retraction.
- CT or MRI guided stereotactic surgery is done for biopsy or excision if the tumor is deeply seated in the brain.

### b- Palliative treatment: includes

- 1- Cerebral dehydrating measures
- 2- Debulking surgery
- 3- Chemotherapy
- 4- Radiotherapy
- 5- Symptomatic treatment (for pain, vomiting, secondaries)

#### ✓ Indications for palliative treatment:

- 1- Deep tumors
- 2- Malignant infiltrative tumors
- 3- Residual & recurrent tumors



## → **SPECIAL TYPES OF BRAIN TUMORS**

### **I. Meningioma**

- They commonly occurs in 4th – 6th decades.
- The second most common primary tumor in CNS.
- They have slight female predominance.
- They are thought to arise from arachnoid villi.
- Macroscopic: round, encapsulated and compress the underlying brain tissue without invasion.
- Microscopic: has whorly appearance with central hyaline material which eventually calcify and form psammoma bodies.
- They are usually benign with long clinical course.
- Signs and symptoms are related to those of ↑ ICT.
- Complete surgical removal is usually curative, however recurrence may occur.

### **II. Glioma**

- Commonest 1ry CNS neoplasm.
- Arises from the supporting tissues of the C.N.S. and therefore is an infiltrating tumor.

**a) Astrocytoma (the commonest brain tumor) .**

**b) Glioblastoma multiformis:**

- is the most common and most aggressive type of primary [brain tumor](#) in humans
- Highly malignant and rapidly growing and is fatal within few months.

### **III. Medullo-blastoma**

- Highly malignant, occurring in children with early S. and S. of increased I.C.T. and archicerebellar manifestations.

### **IV. Neurofibroma**

- Arises from the Schwann cells of the nerve sheaths.
- It is benign and its commonest site is the 8<sup>th</sup> nerve in the cerebello-pontine angle (acoustic neuroma).

### **V. Craniopharyngioma**

- Arises from the cell-crests of Rathk's pouch, commonly before the age of 15 years.
- It is liable to calcification and cystic degeneration.
- It presents by endocrinal manifestations (due to pressure on the pituitary) and by visual disturbances (due to pressure on the optic chiasma, nerve or tract).

# Hydrocephalus

## Anatomical consideration

**Secretion by choroid plexus → Lateral ventricles → through foramen of Monro → third ventricle → through aqueduct of sylvius → fourth ventricle → exits through the foramina of Luschka and Magendie → the subarachnoid space → absorption through the arachnoid granulations into the venous system.**

## Definition

- A disturbance of formation, flow, or absorption of cerebrospinal fluid (CSF) that leads to an increase in volume of ventricular system

- ▶ **Etiology:** children (cong., acquired), adults
- ▶ **C/P:** - *infants:* macrocephaly, delayed milestones
  - *Children:* ↑ ICT, ↓ mental capacity
  - *Elderly:* ↑ ICT, magnetic gait, dementia
- ▶ **Invest.:** CT, MRI
- ▶ **TTT:** - *medical:* (↓ ICT, symptomatic, of the cause)
  - *Surgical:* shunts

## Anatomical types

### a- Communicating hydrocephalus:

- ↑ CSF pressure inspite of full communication between the ventricles and subarachnoid space.
- **Causes:**
  1. Defective absorption of CSF (**most often**).
  2. Impaired venous drainage (**occasionally**).
  3. Overproduction of CSF (**rare**)

### b- Non-communicating hydrocephalus:

- ↑ CSF pressure due to CSF flow obstruction within the ventricular system or in its outlets to the arachnoid space, resulting in impairment of the CSF from the ventricular to the subarachnoid space.
- The most common form of non-communicating hydrocephalus is obstructive.

## Incidence

- The incidence of hydrocephalus is 1 per 1,000 live births;

## Pathophysiology

- ↑ intracranial pressure → dilatation of the ventricle → pressure on brain tissue (Mantle brain)

## Etiology

### A. Congenital causes in infants and children:

- **Brainstem malformation causing stenosis of the aqueduct of Sylvius:** This is responsible for 10% of all cases of hydrocephalus in newborns.
- **Dandy-Walker malformation:** This affects 2-4% of newborns with hydrocephalus.
- **Arnold-Chiari malformation**
- **Agenesis of the foramen of Monro**
- **Congenital toxoplasmosis.**

### B. Acquired causes in infants and children :

- **Mass lesions:** tumors (e.g. medulloblastoma, astrocytoma), cysts, abscesses, or hematoma
- **Hemorrhage:** Intraventricular hemorrhage can be related to prematurity head injury, or rupture of a vascular malformation.
- **Infections:** Meningitis (especially bacterial)
- **Idiopathic**

**C. Causes of hydrocephalus in adults:**

- Subarachnoid hemorrhage.
- Idiopathic hydrocephalus represents one third of cases of adult hydrocephalus.
- Head injury.
- Tumors can cause blockage anywhere along the CSF pathways.
- Meningitis.

**Clinical picture****SYMPTOMS**➤ **In infants :**

- Head enlargement
- Poor feeding
- Irritability
- Reduced activity
- Vomiting
- Delayed motor and mental milestones.

➤ **In children :**

- Slowing of mental capacity
- Headaches (initially in the morning) that are more significant than in infants because of skull rigidity
- Neck pain
- Vomiting, more significant in the morning
- Blurred vision: This is a consequence of papilledema and later of optic atrophy
- Double vision: This is related to unilateral or bilateral sixth nerve palsy.
- Difficulty in walking secondary to spasticity

➤ **In elderly:**

- **Gait disturbance** is usually the first symptom and may precede other symptoms by months or years. Magnetic gait is used to emphasize the tendency of the feet to remain "stuck to the floor" despite patients' best efforts to move them.
- **Dementia**
- **Urinary incontinence** may present as urgency, frequency, or a diminished awareness of the need to urinate.

**SIGNS**➤ **Infants or newborn:**

- **Macrocephaly:** Head circumference is at or above the 98<sup>th</sup> percentile for age.
- **Dysjunction of sutures:** This can be seen or palpated.
- **Dilated scalp veins:** The scalp is thin and shiny with easily visible veins.
- **Tense fontanelle:**
- **McEwen's sign:** resonant note on percussion of skull.
- **Sunset sign:**, Associated congenital anomalies ;(meningocele, Arnold Chiari,...)

➤ **Adults :**

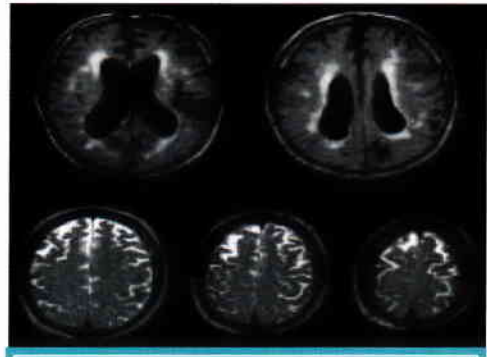
- **Papilledema:** If raised ICP is not treated, it leads to optic atrophy.
- **Unsteady gait**
- **Unilateral or bilateral sixth nerve palsy** (diplopia due to lateral rectus muscle paralysis) is secondary to increased ICP.

## Investigations

- **CT and MRI** can assess the size of ventricles and other structures. **(investigations of choice)**
- MRI can evaluate for Chiari malformation or tumors.
- Ultrasonography through the anterior fontanelle in infants is useful.
- Skull radiographs: Separation of cranial sutures in infants, silver beaten appearance in younger child.
- Continuous CSF pressure monitoring can help in predicting a patient's response to CSF shunting.
- Transillumination to the head.
- PET (positron emission topography).



Non-communicating obstructive hydrocephalus



Communicating hydrocephalus with surrounding atrophy

## Treatment

### Medical Care

- Medical treatment in hydrocephalus is used to delay surgical intervention.
- It may be tried in premature infants
- Decreasing CSF secretion by the choroid plexus → Acetazolamide and frusemide

### Anticonvulsants

### Treatment of the cause

### Surgical treatment

- It is the preferred therapeutic option → shunts.
- The principle of shunting is to establish a communication between the CSF (ventricular or lumbar) and a drainage cavity (peritoneum, right atrium, pleura)
- **A ventriculoperitoneal (VP) shunt:**
  - It is used most commonly.
  - The lateral ventricle is the usual proximal location.
  - **Advantages:**

The need to lengthen the catheter with growth may be obviated by using a long peritoneal catheter.

## Follow-up

### Further Inpatient Care

- Patients with shunt-dependent hydrocephalus should be admitted for consideration of shunt revision if shunt malfunction or infection is suspected.
- In children, shunt revisions are scheduled according to growth rate.



**Prognosis**

- Long-term outcome is related directly to the cause of hydrocephalus.
- Up to 50% of patients with large intraventricular hemorrhage develop permanent hydrocephalus requiring shunt.
- Satisfactory control was reported for medical treatment in 50% of hydrocephalic patients younger than 1 year who had stable vital signs, normal renal function, and no symptoms of elevated ICP.

**More details****→ Surgical treatment of hydrocephalus:**

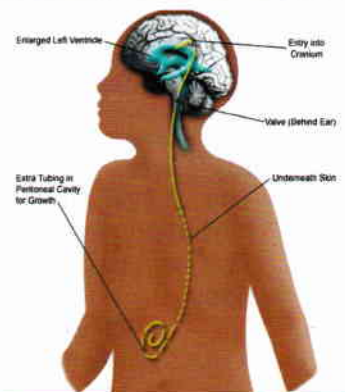
1. Choroid plexectomy.
2. Third ventriculostomy.

**→ Types of shunts**

| Type of shunt                   | Proximal location    | Distal location | comment                                              |
|---------------------------------|----------------------|-----------------|------------------------------------------------------|
| <b>Ventriculoperitoneal</b>     | Ventricle            | Peritoneum      | Most common                                          |
| <b>Ventriculo-Atrial</b>        |                      | atrium          | Used when Ventriculoperitoneal shunt isn't available |
| <b>Ventriculo-Pleural</b>       |                      | Pleura          | Risk of hydrothorax                                  |
| <b>Ventriculo-cisternal</b>     |                      | Cisterna magna  | rare                                                 |
| <b>Cysto,subduro-peritoneal</b> | Cyst, subdural space | Peritoneum      | In subdural hygroma                                  |
| <b>Lumbo-peritoneal</b>         | Lumbar theca         | peritoneum      | In communicating hydrocephalus                       |

**→ Complications of shunts:**

1. **Obstruction.**(ttt→revising the shunt and replacing the malfunctioning component.)
2. Undershunting.
3. Overshunting, subdural hge or low-pressure state.
4. **Infection.**(ttt →shunt is removed + IV Abs "2 weeks" + external vent. drain + another shunt is inserted)
5. Related to hardware: kinking, separation and dislodgment, shortening by age.
6. Focal glomerulonephritis.
7. Acute shunt failure.



Ventriculo-peritoneal shunt

# Brain Abscess

## Definition

- Mass of immune cells, pus & other materials due to a bacterial or fungal infection.

## Etiology

## Organism

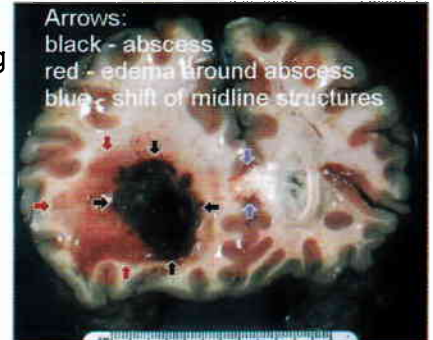
- Gram +ve bacteria: e.g. Staph.
- Gram -ve bacteria: due to nosocomial infections.
- Mycobacterium tuberculosis.
- Anaerobic organisms: due to improvements in techniques for bacterial isolation.
- Fungi, parasites, or other opportunistic organisms in immunocompromised.

## Route

- **Direct spread:**
  - (The majority) from a contagious suppurative focus e.g. paranasal sinusitis, otitis media, or mastoid infection.
  - **Dural opening:** whether traumatic or surgical.
  - **Skull defects:** which are acquired (e.g. cholesteatoma of the middle ear), post-traumatic or after previous craniotomy or congenital.
- **Hematogenous:** dissemination from a primary site (e.g. from dental or tonsillar abscess).

## Predisposing factors

- **Immunocompromised patients:** (e.g. those receiving immunosuppressive therapy for transplantation, or victims of AIDS) are more prone to affection.
- **Open head injuries** (e.g. depressed fracture).
- **Otitis.**
- **Sinusitis.**
- **Congenital heart disease** e.g. right to left shunt



## Pathology

- The single most important response that limits the spread of infection → the formation of the collagen capsule in a developing abscess.
- The abscess have 5 distinct zones different from abscesses in different sites of the body:
  1. A well formed necrotic centre.
  2. Peripheral zone of macrophages & fibroblasts.
  3. A dense collagen capsule.
  4. A layer of neovascularization outside the capsule.
  5. Reactive astrocytosis & gliosis of the surrounding brain.

## Clinical Picture

→ Infection causing mass in the brain

### 1- Infection:

- FAHM (low grade fever in half of the cases).
- The commonest symptom is progressively severe headache that is resistant to analgesics.
- Tachycardia – rigors.

**2- Mass (↑ ICP):**

- Headache.
- Stiff neck, shoulders or back.
- Vomiting.
- Blurring of vision.
- Disturbed conscious level in about 50% of the caases:
  - o Inattention
  - o Drowsiness
  - o Confusion
  - o Coma

**3- Brain (focal lesion):****a. Irritation:**

- Sensory: tingling – numbness
- Motor : muscle twitches, convulsions.

**b. Destruction:**

- Sensory: General: hypothesia, loss of sensation.  
Special: blindness - deafness
- Motor : paresis up to paralysis

**Complications**

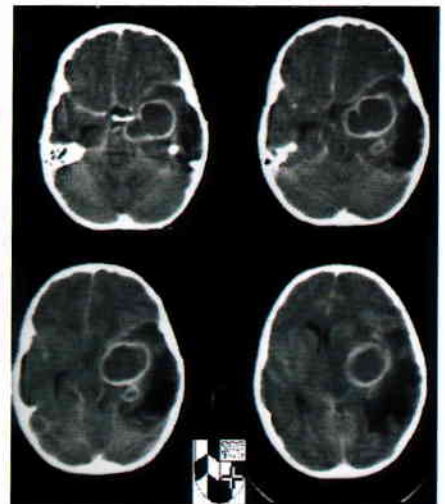
1. Meningitis, severe & life threatening.
2. Epilepsy
3. Permanent neurological losses (vision, speech, movement).
4. Recurrence of infection.
5. Abscess rupture into the ventricle & subarachnoid space.
6. Herniation secondary to mass effect.

**Investigations****Laboratory**

- All of these changes are nonspecific and of little help in the diagnosis:
  - ↑WBC, ↑ESR.
  - Lumbar puncture is contraindicated to avoid a fatal conization.

**Radiological**

- CT± contrast or MRI with gadolinium enhancement is the investigation of choice.
- CT shows a smooth, thin, regular contrast medium enhanced wall with a central region of hypodensity. It is often difficult to differentiate this appearance from that of other CNS processes, including primary and metastatic tumors, infarction, hematomas, and radiation necrosis. MRI with gadolinium enhancement more readily detects cerebritis stage

**Investigations for the source**

- CXR
- ECHO
- CT sinuses

## Treatment

→ A brain abscess is a medical emergency

**1- Hospitalization.**

**2- Life support measures.**

**3- Then the suggested general regimen is:**

**a. Surgical drainage is the rule.**

**b. Medication :**

- Parenteral antibiotics + steroids till the result of C & S.
- Indications:
  - Several abscesses (rare).
  - A small abscess (< 2cm).
  - An abscess deep within the brain.
  - Associated meningitis.
  - An underlying disease that makes surgery dangerous.

**c. Stopping medication & return to surgical option**

- Indicated if:
  - Pressure in the brain continues or gets worse.
  - The size of the brain abscess does not ↓ after medication.
  - The brain abscess contains gas.
  - The brain abscess ruptured.

▪ Techniques:

**1- ASPIRATION:**

- Indications:
  - a. Deeply seated lesions.
  - b. Multiple abscesses.
  - c. A critical location (e.g., motor or speech area).
  - d. Poor general condition of the patient.

**2- EXCISION:**

- Indications:
  - a. Multilocular abscess.
  - b. Thick abscess wall.
  - c. Fungal abscesses.
  - d. A superficial abscess.

## Prognosis

- If untreated, a brain abscess is almost always deadly.
- Within treatment, the death rate is about 10%.
- The earlier the treatment is received, the better.
- Some patients may have long-term neurological problems after surgery.



# Spina Bifida (Spinal dysraphism)

## Definition

- Failure of the fetus spine to close properly during the first month of pregnancy.

## Etiology

- The causes of spina bifida are not completely understood.
- Incriminated risk factors include:
  - 1- Folic acid deficiency.
  - 2- Positive family history
  - 3- Having a baby with a neural tube defect
  - 4- Poorly controlled diabetes
  - 5- Anticonvulsants intake

## Types

### I. Spina bifida occulta

- Pathophysiology:**
  - The development is nearly complete except for a bifid spine covered by intact skin.
  - The skin is connected to the meninges by a fibrous band (membrana reuniens)
  - There may be no evidence of the presence of bifid spine or there may be:
    - Lipomatous tumor.
    - Skin dimple.
    - Tuft of hair.
    - Midline lumbar capillary hemangioma.
- C/P:**
  - In most cases: asymptomatic till puberty.
  - In minor cases: Urinary incontinence at puberty.
  - At 1<sup>st</sup> nocturnal enuresis due to unequal growth of spinal cord & vertebral column or other nervous manifestations.
- Treatment:**
  - Usually not required
  - In neurologic affection: cutting of the traction band or membrane.

#### •Why symptoms arise at puberty?

- It is a period of maximum elongation of vertebral column → max. traction on "membrana reuniens"

#### •What is the cause of sphincteric disturbance?

- The meninges are pulled from the back → traction on motor tracts → tracts of sphincteric control 1<sup>st</sup> to suffer as they are last fibers to be myelinated

### II. Spina bifida Overta

#### A. Meningocele:

- Pathophysiology:**
  - Bulging of the meninges only through the spinal defect.
  - It does not contain nervous tissue.
- Sites:**
  - Lumbosacral region.
  - Back of neck (D.D. with lipoma).

- **C/P:**
  - Swelling which is:
    - Cystic.
    - Translucent.
    - Compressible.
    - Gives expansile impulse on cough.
  - Mostly neurologically normal.
- **Associated anomalies:** rare.
- **Treatment:**
  - If there is a CSF leak urgent repair is required. Otherwise elective pain is planned
  - Better to be during the first few months of life.

### **B. Meningo- myelocele:**

- It is the **commonest** type of manifest spina bifida.
- **Pathophysiology:**
  - Protrusion of spinal cord and roots through the bony defects within covering of meninges and / or skin.
  - The meningeal covering may rupture and the spinal cord & roots lie exposed to air, CSF may leak from open lesions.
- **C/P:**
  - The protruding roots & cord are usually functionless
  - A dilated bladder & a patulous anus might be present.
- **Associated anomalies:**
  - Hydrocephalus.
  - Aqueduct Forking.
  - Arnold-Chiari malformation (type II).
- **Treatment:**
  - The lesion should be repaired as soon as possible (within 24-48 hrs) due to neurological defect
  - Immediate closure & replacement of the neural tissue into the spinal canal to prevent infection.
  - If untreated 75 % of cases die within the first year of life.

### **C. Myelocele (complete spina bifida)**

- No fusion of the neural tubes.
- So, the defect is occupied by open spinal plate appearing as red granular area with CSF coming from its center.
- The lesion is incompatible with life → fatal in 100 % of cases.

### **D. Syringomyelocele:**

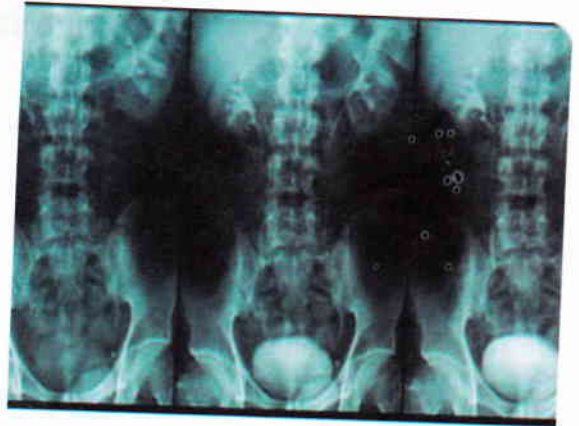
- A rare form where the central canal is dilated.

## **Diagnosis**

- **Prenatal Diagnosis:**
  - The most common screening methods used to look for spina bifida during pregnancy are second trimester maternal serum alpha fetoprotein (MSAFP) screening and fetal ultrasound.
- **Postnatal Diagnosis:**
  - Mild cases: detected by X-ray during a routine examination.
  - More severe forms of spina bifida often have muscle weakness in their feet, hips, and legs: magnetic resonance imaging (MRI) or a computed tomography (CT) scan to get a clearer view of the spine and vertebrae.
  - If hydrocephalus is suspected: CT scan and/or X-ray of the skull

### Prevention

- Folate one month before conception and during 1st trimester can prevent up to 70% of cases.



# Injuries of the Spine

## Fracture Spine

### Definition

- Disturbance of the normal continuity of vertebrae.
- It may be isolated fracture or fracture dislocation.

- ▶ **Etiology:** trauma, pathological fracture
- ▶ **C/P:** as trauma + neurological symptoms
- ▶ **Comp.:** Spinal cord injury, Shock
- ▶ **Invest.:** X-ray, for comp., for the cause
- ▶ **TTT:** as trauma then acc. to type  
(Stable or unstable)

### Incidence

- More in males (more exposure to mechanism of injury)
- Most commonly affected spine at the junction of mobile and rigid parts at lower cervical and dorso-lumbar regions.

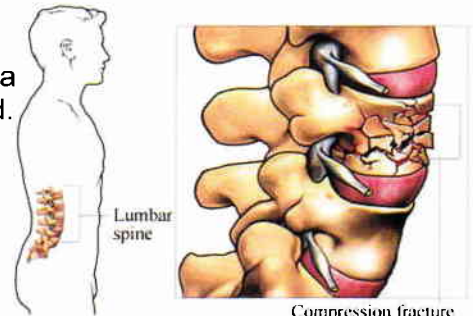
### Etiology

#### I- TRAUMA.

- a. **Hyper-flexion trauma:**
  - This is the most frequent trauma, e.g., fall of a heavy object on the back of the trunk or head.
- b. **Hyper - flexion and rotation.**
- c. **Vertical compression trauma:**
  1. Fall from height on the feet.
  2. Fall on the head.
- d. **Hyper-extension injuries:** uncommon.

#### II-PATHOLOGICAL FRACTURES:

- a. Metastases.
- b. Osteoporosis.



Compression fracture

### Types

#### A. According to morphology:

1. **Wedge compression fracture:**
  - Hyper-flexion trauma crushes the vertebral body into the shape of a wedge.
2. **Fracture dislocation:**
  - Commonly there is damage to the spinal cord and nerve roots.
3. **Dislocation:**
  - Pure dislocation without fracture is common in cervical vertebrae because its articular processes are rather horizontal.
4. **Comminuted (burst) fracture:**
  - This is an uncommon injury due to vertical compression of the straight spine.
5. **Avulsion fractures of transverse and spinous processes:**
  - Not accompanied by neurological injury and require no special treatment.
6. **Dislocations and fracture dislocations of the atlas and axis vertebrae:**
  - Serious as they may be fatal because of trans section of the cord above the level of innervation of respiratory muscles.
  - Atlas dislocation can occur with or without fracture of odontoid process (hangman's fracture).



**B. According to stability:**

- ▶ Stability of the spine fractures depends on the integrity of the posterior ligaments; the interspinous, supraspinous and ligamentum flavum
  - **Stable fractures:** Have intact posterior ligaments, e.g., wedge compression, comminuted and avulsion fracture of the transverse and spinous processes.
  - **Unstable fractures:** Have torn posterior ligaments and are liable to injure the cord and nerve roots, these include fracture dislocation and pure dislocation.

**Neurological injury**

- Paraplegia or quadriplegia is the result of injury of the spinal cord or nerve roots or both.
- It is important to diagnose the level of the lesion as well as its nature to whether recovery is expected or not.

**a-Level of lesion:**

- See the table.

**b-Nature of lesion****1. Spinal cord concussion:**

- Like cerebral concussion and nerve concussion, recovery is the rule.

**2. Spinal cord damage by contusion or laceration (transection):**

- These do not recover.
- Types of spinal cord transection are:
  - i. Complete transection.
  - ii. Hemisection (Brown-Sequard syndrome).

**3. Cauda equine injury:**

- a. Spine injury is suspected after major trauma or if the patient is unconscious after the injury.
- b. Other injuries of the skull, chest, abdomen, limbs should be searched for.
- c. Local signs
  - Slight kyphosis may be felt or visible.
  - There is local tenderness over the spinous processes. No gap is felt between the spinous processes in a stable fracture and vice versa in unstable fractures.
  - No attempt should be made to test for back movements as this may induce paraplegia.
- d. Neurological assessment
  - Motor power.
  - Sensations.
  - Reflexes.

**Clinical Picture****Complications**

- 1- Spinal cord and/or root injury including roots of cauda spina
- 2- Shock may be:
  - a- Spinal shock
    - Sympathetic affection leading to loss of vascular tone & bradycardia
    - loss of muscle tone → venous pooling & hypovolemia
  - b- Hemorrhage lead to true hypovolemia

**Investigations**

- A- For diagnosis:** plain X-ray spine, AP and lateral
- B- For complications:** CT and MRI
- C- For detection of cause** of pathological fracture

## Treatment

### A. Initial management

- When fracture of the spine is suspected, movements of the spine must be prevented.
- A cervical collar is applied and the head is immobilized during transport and during examination.
- The trauma victim is moved on to the stretcher all in one piece; he should never be lifted by the shoulders and the thighs.
- In the hospital, the patient is nursed on a bed with fracture boards. Shock must be treated. Associated injuries may require urgent treatment.

### B. Stable fractures

#### 1) Wedge compression fracture:

- ❑ The fracture is disregarded. The patient is put in bed and is taught extension exercises for the back muscles. Within a month, he is allowed up.
- ❑ He can resume work in 3 months.
- ❑ A painless, mobile, and powerful back is achieved in spite of the fact that the compressed vertebra remains wedge shaped.

#### 2) Comminuted fracture:

- ❑ Pain is usually severe and healing is delayed. A plaster jacket is applied in the neutral position (straight spine; not hyperextended) for 3 months.
- ❑ The patient can walk with the plaster on.
- ❑ Spinal exercises must be practiced regularly as soon as the plaster jacket has been applied.

#### 3) Avulsion fractures of the transverse or spinous processes:

- ❑ Rest and analgesics.

### C. Unstable fractures

#### 1) No neurological deficit:

- ❑ Reduction and immobilization are required to prevent spinal cord injury.
- ❑ This is later followed by physiotherapy for rehabilitation.

#### 2) Cervical spine:

- ❑ Traction using tongs for 6 weeks is followed by a cervical collar for one month. Open reduction and internal fixation by plates may be needed.

#### 3) Thoraco-dorsal spine:

- ❑ Reduction by gentle extension is followed by fixation in a plaster cast in mild extension.
- ❑ If closed reduction is not possible, open reduction and internal fixation is the alternative.

#### 4) Evident cord transection

#### 5) Care of paraplegic patient.

## Segmental Spinal Cord Level and Function

| Level                 | Function                                                                                                            |
|-----------------------|---------------------------------------------------------------------------------------------------------------------|
| <u>C1-C6</u>          | Neck flexors                                                                                                        |
| <u>C1-T1</u>          | Neck extensors                                                                                                      |
| <u>C3, C4, C5</u>     | Supply diaphragm (mostly C4)                                                                                        |
| <u>C5, C6</u>         | Shoulder movement, raise arm (deltoid); flexion of elbow (biceps); <b>C6</b> externally rotates the arm (supinates) |
| <u>C6, C7</u>         | Extends elbow and wrist (triceps and wrist extensors); pronates wrist                                               |
| <u>C7, T1</u>         | Flexes wrist                                                                                                        |
| <u>C7, T1</u>         | Supply small muscles of the hand                                                                                    |
| <u>T1 -T6</u>         | Intercostals and trunk above the waist                                                                              |
| <u>T7-L1</u>          | Abdominal muscles                                                                                                   |
| <u>L1, L2, L3, L4</u> | Thigh flexion                                                                                                       |
| <u>L2, L3, L4</u>     | Thigh adduction                                                                                                     |
| <u>L4, L5, S1</u>     | Thigh abduction                                                                                                     |
| <u>L5, S1, S2</u>     | Extension of leg at the hip (gluteus maximus)                                                                       |
| <u>L2, L3, L4</u>     | Extension of leg at the knee (quadriceps femoris)                                                                   |
| <u>L4, L5, S1, S2</u> | Flexion of leg at the knee (hamstrings)                                                                             |
| <u>L4, L5, S1</u>     | Dorsiflexion of foot (tibialis anterior)                                                                            |
| <u>L4, L5, S1</u>     | Extension of toes                                                                                                   |
| <u>L5, S1, S2</u>     | Plantar flexion of foot                                                                                             |
| <u>L5, S1, S2</u>     | Flexion of toes                                                                                                     |

# Disc Prolapse

## Definition

- A condition results from rupture of annulus fibrosus with herniation of nucleus pulposus causing compression on nerve roots or spinal cord.
- There are 2 Classes according to onset → acute & chronic

- ▶ **C/P:** - **Lumbar:** paralysis, pain then → ↓ sens., sphincteric disturbances
- **Cervical:** Lateral: LMNL, pain → ↓ sens.  
Central: UMNL, ↓ sens.
- ▶ **Invest.:** MRI (invest. of choice)
- ▶ **TTT:** - **Lumbar:** lateral: conservative, surgery  
Central: urgent surgery
- **Cervical:** neck collar, analgesics, decompression

## Incidence (it occurs in the most mobile segments of the spine)

- 80% (L<sub>4</sub>/L<sub>5</sub> – L<sub>5</sub>/S<sub>1</sub>) → "lumbar disc prolapse".
- 20% (C<sub>5</sub>/C<sub>6</sub> – C<sub>6</sub>/C<sub>7</sub>) → "cervical disc prolapse"

## Pathology

- ▶ According to direction of prolapsed
  - Lateral → compression of nerve roots.
  - Posterior → compression of spinal cord

## Clinical picture

### I- Lumbar disc prolapse:

- ▶ **Motor**
  - A. Weakness or paralysis in L.Ls (LMN nature).
- ▶ **Sensory**
  - A. Pain which is radicular & referred to L.L.
  - B. Hyposthesia or anaesthesia later on.
  - C. Loss of superficial & deep sensations.
- ▶ **Autonomic**
  - A. Sphincteric disturbances (S<sub>2,3,4</sub>).
  - B. Vasomotor changes.

|                                 | Lateral disc prolapse | Central disc prolapse |
|---------------------------------|-----------------------|-----------------------|
| <b>S &amp; S</b>                | Unilateral            | Usually bilateral     |
| <b>Sphincteric disturbances</b> | Not present           | May be present        |

## Cauda equina syndrome

Due to compression from massive ruptured disc mostly L4 - L5

### Clinical picture:

1. Motor weakness (may progress to paraplegia)
2. Saddle anesthesia (perineum, genitalia & buttocks)
3. Bilateral sciatica
4. Urinary retention or incontinence
5. Fecal incontinence

## Herniated Upper lumbar disc

L1- L2 or L2 - L3

- In 1% of cases
- weakness of Quadriceps femoris
- paraesthesia & pain in anterior thigh



**II- Cervical disc prolapse:****a. Lateral prolapse "Root compression"**

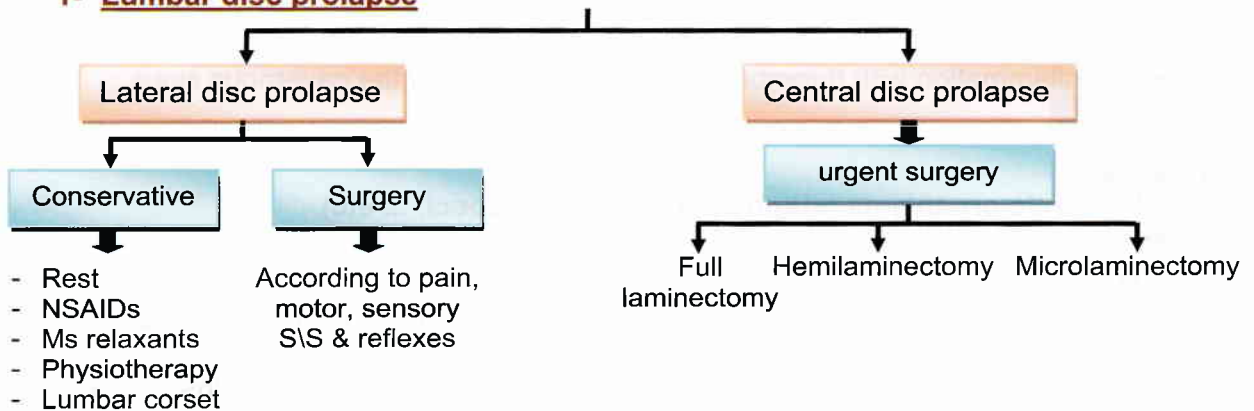
- 1- Anterior root compression → LMNL in muscles supplied by the compressed root.
- 2- Posterior root compression → pain & paraesthesia followed by hypoesthesia or anaesthesia.

**b. Posterior (central) prolapse "Cord compression"**

- 1- Compression of pyramidal tract → UMNL below level of compression.
- 2- Compression of spinothalamic tract → superficial sensory loss below the level of compression.
- 3- Compression of posterior column → deep sensory loss below the level of compression.

**Investigations**

- MRI (the investigation of choice).
- C.T. scan.
- Plain lumbosacral X-ray.

**Treatment****1- Lumbar disc prolapse****2- Cervical disc prolapse**

- A.** Neck collar to limit movement of the neck.
- B.** Analgesics
- C.** Urgent decompression (in cord compression)

# Cavernous Sinus

## Anatomy of the cavernous sinus

(1) **Nature:** the cavernous sinuses are 2 venous channels formed by splitting of dura matter.

(2) **Site:** on each side of the pituitary body and the body of sphenoid.

(3) **Contents:**

A) In the sinus:

- 1- Internal carotid artery.
- 2- Abducent nerve.

B) In the lateral wall of the sinus:

From above down are the 3<sup>rd</sup>, 4<sup>th</sup> and 1<sup>st</sup> and 2<sup>nd</sup> divisions of 5<sup>th</sup> cranial nerves.

## Cavernous Sinus Thrombosis

### Definition

- It is inflammation with thrombosis (thrombophlebitis) of the cavernous sinus.

### Etiology

#### Organism

- Pyogenic organisms (staphylococci, streptococci, ... etc).

#### Route

##### ➤ Hematogenous:

- Along the communicating veins from the orbit, face, middle ear, side of the head, mouth and paranasal sinuses.  
(Anterior facial V. → deep facial V. → pterygoid plexus of veins → emissary veins → cavernous sinus)

##### ➤ Endogenous infection: Rare.

### Predisposing factors

- Depressed immunity

### Clinical Picture

- a) As the clinical picture of infection: FAHM but more severe.
- b) In addition: usually bilateral due to spreading infection to the other cavernous sinus through the intercavernous plexus:
  - 1) Severe supraorbital pain: due to involvement of the branches of the ophthalmic division of 5<sup>th</sup> cranial nerve
  - 2) Edema: behind the ear (over the mastoid bone): due to thrombosis of the mastoid emissary vein.
  - 3) Proptosis: rapidly progressive and becomes bilateral usually.
  - 4) Pupil dilatation with total ophthalmoplegia: due to paralysis of the ocular motor nerves 3<sup>rd</sup>, 4<sup>th</sup> and 6<sup>th</sup> cranial nerves.
  - 5) Fundus changes:
    - Engorgement of retinal veins.
    - Papilledema.

**Complication**

⇒ **Death usually occurs due to complications:**

- (1) Meningitis and brain abscess.
- (2) Pulmonary complications as pulmonary embolism or infection.

**Treatment****A. Hospitalization in ICU:**

⇒ **The disease is fatal if the treatment is not given early:**

- a. Rest in bed, tonics and analgesics.
- b. Systemic antibiotics in massive doses.
- c. Anticoagulants.
- d. Corneal protection from exposure keratitis (by antibiotic eye ointment, eye pad and bandage).

**B. Treatment of complications**

# **C H A P T E R**

# **3**

## ***Plastic surgery***

- Burn
- Principles of skin coverage
- Aesthetic surgery.
- Pressure ulcers
- Skin and subcutaneous tissue
- Muscles , tendons and fascia
- Hands and feet
- Face, lips and palate
- Mouth, cheek and tongue
- Teeth, gums and jaws



# Burn

## Burn scheme

### Definition

### Etiology & types

### Classification

### Pathophysiology

### Complications

### Management

### Definition

- Necrosis of tissues by physical or chemical agents

### Etiology & Types

#### A-Physical Burns

##### i. Thermal (75% of all burns):

1. Scalds are caused by boiled liquids; they often affect children.
2. Flame burns can affect any age and is the most common burn industrial accident.
3. Contact burns due to direct contact with hot objects (e.g. irons).
4. Steam burns: also steam inhalation can cause thermal injuries to the airway.

##### ii. Electrical burns:

- a. High voltage >1000 volt → marked tissue damage
- b. low voltage <1000 volt → minimal tissue damage

##### iii. Radiation burns (irradiation therapy – sun rays)

#### B-Chemical burns Due to alkalis or acids.

- ▶ **Etiology:** physical, chemical
- ▶ **Class.:** acc. to extent, depth
- ▶ **Path.:** injury, healing
- ▶ **Comp.:** systemic, local (infection\*)
- ▶ **TTT:** ABCD → definitive ttt:  
(resuscitation, fluids, nutrition, local ttt)

### Classification of burns (assessment of burns)

#### ➤ According to the extent (in relation to total body surface area "TBSA"):

- **A major burn**
  - More than 30 % of the body surface area.
- **An intermediate burn**
  - 15 - 30% in adults.
  - 10 - 30% in children.
- **A minor burn**
  - Less than 15 % in adults.
  - Less than 10 % in children.

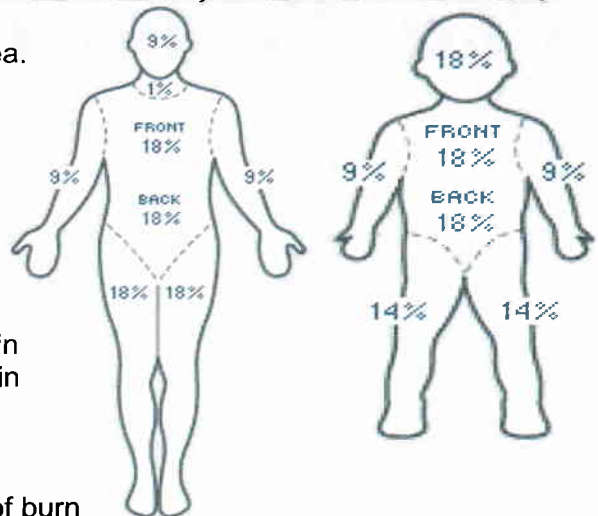
#### ▪ This is estimated by:

##### a- Rule of 9:

- This method is easy but not accurate in children due to large size of the head in relation to the rest of the body.

##### b- Lund and Browder charts:

- More accurate in all age groups
- Correlation between age, area, depth of burn



According to the depth:

|                         | 1 <sup>st</sup> degree                                                                                                                             | 2 <sup>nd</sup> Degree                                                                                                                                                                                                                                        | 3 <sup>rd</sup> degree                                                                                                                                                                                |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Damage</b>           | <ul style="list-style-type: none"> <li>Only the epidermis → erythema of skin usual example is sunburn.</li> </ul>                                  | <ul style="list-style-type: none"> <li>Epidermis + portion of dermis.</li> </ul>                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Complete destruction of epidermis and dermis.</li> </ul>                                                                                                       |
| <b>Healing</b>          | <ul style="list-style-type: none"> <li>Heal rapidly</li> </ul>                                                                                     | <ul style="list-style-type: none"> <li>Epidermal regeneration can occur from remnants of hair follicles and sweat glands in dermis provided that no infection.</li> <li>If infection → destruction of epithelial remnants → 3<sup>rd</sup> degree.</li> </ul> | <ul style="list-style-type: none"> <li>No healing only migration of Epithelium from edges of burnt area</li> <li>separation of eschar by 3<sup>rd</sup> week</li> <li>Skin graft is needed</li> </ul> |
| <b>Appearance</b>       | <ul style="list-style-type: none"> <li>Forms blisters surrounded by erythema</li> <li>Their surface is moist due to exudation of plasma</li> </ul> |                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>White or black eschar</li> <li>The area is dry</li> <li>Possible visible thrombosed S.C vessels</li> </ul>                                                     |
| <b>Presence of pain</b> | <ul style="list-style-type: none"> <li>Painful</li> <li>Sensitive to air (can be elicited by pinprick test)</li> </ul>                             |                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Painless (due to loss of terminal nerve endings)</li> </ul>                                                                                                    |

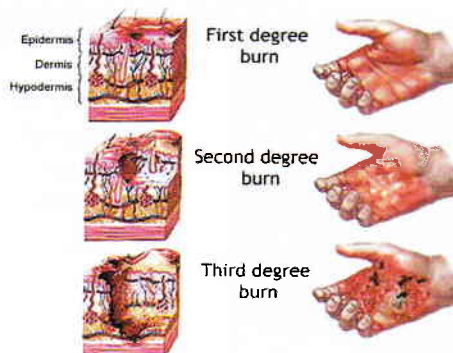
1<sup>st</sup> degree

2<sup>nd</sup> degree

3<sup>rd</sup> degree


- For simplification, the burns can be classified into:
  - Superficial → 1st and 2nd degree.
  - Deep → 3rd degree.

- **2<sup>nd</sup> degree of burn is further subdivided into.**
- 1- Superficial: heals with epithelization in 10-14 days.
  - 2- Deep: heals more slowly (22-25 days)



## Pathology

### A. Injury

#### 1. Immediate direct cellular injury

Consist of 3 zones :

|                                              | <b>Etiology</b>       | <b>Fate</b>                                                            |
|----------------------------------------------|-----------------------|------------------------------------------------------------------------|
| 1-Central zone of coagulation                | Necrosis              | Eschar formation → separation after 3 weeks                            |
| 2-Intermediate zone of stasis (degeneration) | Ischemia              | Viable tissue which may:<br>- Die after 48 hours<br>- Or remain viable |
| 3-Outer zone of hyperemia (inflammation)     | Inflammatory reaction | - Recover within 7-10 days<br>- OR become infected                     |

#### 2. Delayed Ischemic injury

### B. Healing

#### 1. Partial thickness burns

Healing by epithelialization within 3 weeks

#### 2. Full thickness burns

Separation of eschar leaving granulation tissue after 4 weeks → fibrosis & scarring

Degree of tissue destruction depends on temp. + duration of exposure to heat  
Rate of tissue healing depends on remaining hair follicles & sweat glands

## Pathophysiology

I. Cellular : Release of Inflammatory mediators as CIL, TNF & Burn toxins → MOF

### II. Vascular:

1. I.V. volume due to evaporation & ↑ capillary permeability → severe hypovolemic shock (especially with deep burn)
2. blood viscosity leading to thrombosis of blood vessels

### III. Metabolic response

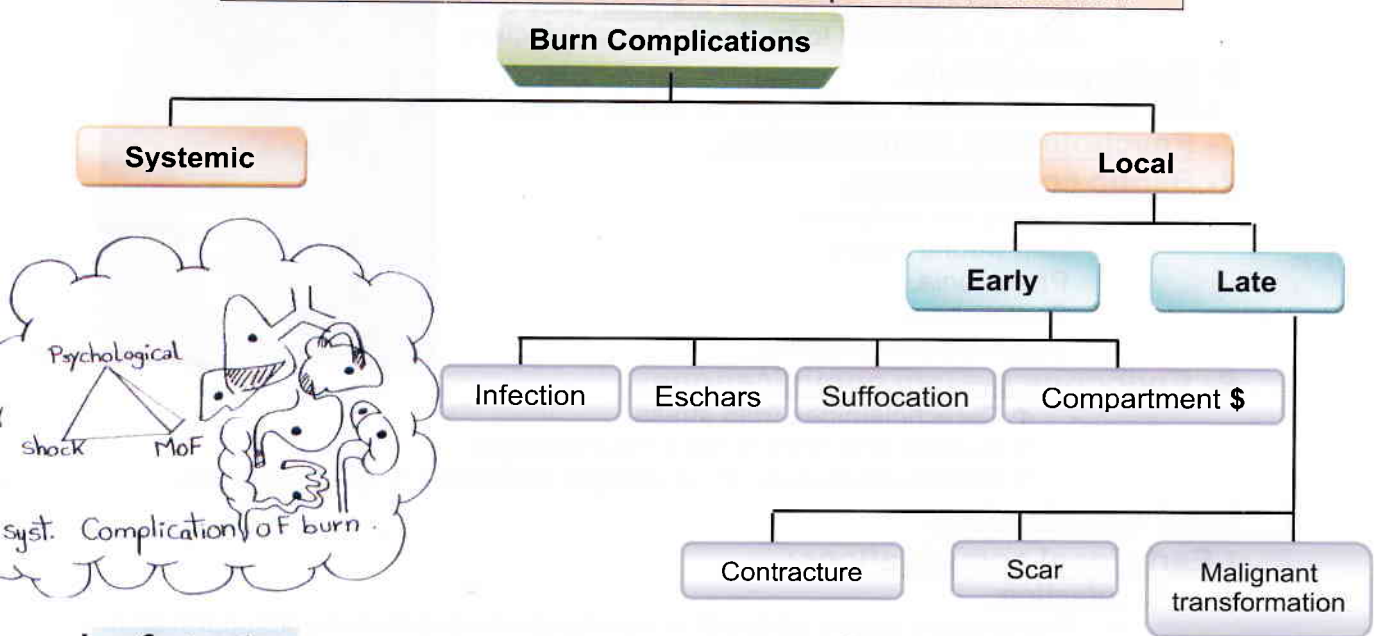
1. It results in hypercatabolic state (each 1L evaporation of water → loses 580 Cal.
2. protein breakdown (-ve nitrogen balance)

### IV. Immunological

Immunosuppression due to defective humoral & cell mediated immunity

## Complications

The primary cause of death in burnt patients is infection.



### I. Systemic:

#### 1- Shock

| Immediate                                  | Early                                                       | Late                                         |
|--------------------------------------------|-------------------------------------------------------------|----------------------------------------------|
| <b>Neurogenic</b><br>from severity of pain | <b>Hypovolemic</b><br>due to under correction of lost fluid | <b>Septic</b><br>after 1 week from infection |

#### 2- Pulmonary complications:

| Immediate                                   | Early                                                                | Late                                                              |
|---------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------|
| <b>Asphyxia</b><br>Due to inhalation injury | <b>Pneumothorax</b><br><b>Pneumonia</b><br><b>Pulmonary embolism</b> | <b>Respiratory failure type II</b><br>Hypoxia, hypercapnia (ARDS) |

#### 3- Cardiovascular complications:

- Acute left ventricular failure.
- Congestive heart failure.
- Arrhythmia (especially in electrical burn).
- Myocardial infarction (either due to stress or hypovolemia & ↑ viscosity).

#### 4- Renal complications:

- Acute tubular necrosis (acute cortical necrosis) due to release of cytokines & ILs.
- Myoglobinuria & hemoglobinuria (especially with electrical burn).
- ARF (due to hypovolemic shock → leading to water & electrolyte imbalance).

#### 5- Gastro-intestinal complications:

- Adynamic ileus**: Acute gastric dilatation due to severe sympathetic stimulation & release of cytokines & ILs. Usually occurs early and may necessitate the insertion of a nasogastric tube.



- b. Curling's Ulcer: due to stress → splanchnic vasoconstriction → Ischemia → destruction of mucosa.
- c. Liver dysfunction: due to ischemia & toxins.
- d. Recently acute ulceration of the colon may occur and it is suggested to be due to fungal infection.

### 6- **Multiorgan failure:**

Often follows pulmonary insufficiency or sepsis → death.

### 7- **Psychological complications.**

### 8- **Septic complications:**

- Urinary tract infection.
- Burn wound sepsis.
- Pneumonia.
- Septic shock.
- Septic thrombophlebitis

### 9- **Endocrine system complications:**

- ↑ Catecholamines from stress.
- ↑ Cortisol and ADH → Na & H<sub>2</sub>O retention.
- ↑ Protein catabolism → -ve nitrogen balance + ↑ glycogenolysis.



## II. **Local complications:**

### I. **Early local complications:**

#### 1. **Infection:**

- The primary cause of death in burnt patients due to immunosuppression.
- It occurs usually between 4 – 7 days post-burn.
- It may be bacterial, viral or fungal.
- It may be either exogenous or endogenous sources.
- Infection may lead to the development of septicemia and septic shock.
- Treatment by proper local burn wound care (discuss).
- The value of systemic antibiotics in the prevention of infection is doubtful.

#### 2. **Constricting eschars:**

- In deep circumferential burns of the limbs → ischemia or the chest → dyspnea due to restriction of chest expansion.
- It should be treated by urgent escharotomy (not painful as nerves are damaged).

#### 3. **Suffocation:**

- Due to edema in burns of the face and neck and may need urgent tracheostomy.

#### 4. **Compartment syndrome:**

- Due to edema of the subcutaneous tissue.

### II. **Delayed (late) local complications:**

#### 1. **Scarring and loss of quality of skin.**

#### 2. **Presence of raw skin areas due to 3rd degree burns.**

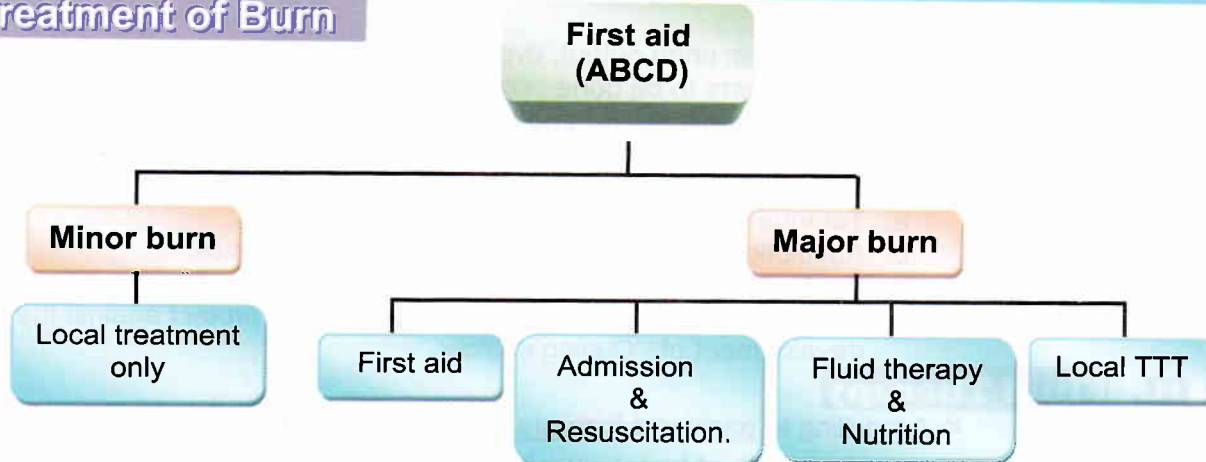
#### 3. **Pigmentary skin changes in the form of hypo/hyper-pigmentation**

#### 4. **Contractures:** across joints.

#### 5. **Scar formation:** (hypertrophic or keloid)

#### 6. **Malignant transformation:** (Marjolin's ulcer) in long-standing unstable scars is rare.

## Treatment of Burn



## A-Definitive treatment of minor burn

*Can be treated as out patients by:*

- **Clean** with antiseptics solution as Savlon® or Betadine®.
- **Dressing** using proper local chemotherapeutic as Silver Sulphadiazine Ointment + Vaseline gauze dressing
- **Give** analgesic and prophylactic systemic antibiotic.
- **Repeat** the dressing for 2 weeks till healing.

## B-Definitive treatment of major burn

## I. First aid

- **Move** the patient from the source of burn (**stop, drop & roll**) and remove the patient's clothes.
- **Airway**: maintained
- **Breathing**: maintained.
- **Circulation**: maintained.
- **Drugs**: IV analgesics (as 50mg pethidine), antitetanic immunoglobulins. Intramuscular injections are avoided as absorption is poor.
- **Exposure**: remove any clothes.
- **Fluid (run) water**: at room temperature immediate immersion in cold water to decrease micro-vascular damage and relieve pain.

Ice cold is contraindicated → ↑tissue damage

## II. Admission &amp; Resuscitation

- **Admission of the patient to burn unit of hospital.**
- **Rsuscitation and monitoring:**
  - Wide bore IV **cannula** is inserted rapidly before the veins get collapsed to give IV fluid therapy and IV antibiotics.
  - A Foley's urethral **catheter** is introduced to check urine output.
  - **Ryle** tube suction and nothing by mouth in the first 48 hours then oral feeding should be started gradually after that.

- **Monitoring:**
  - Vital signs: urine output, cvp, consciousness level.
- **Laboratory tests** to be done : complete blood picture, arterial blood gases, serum electrolytes, liver and kidney function tests.
- Calculate total burn size and estimate the depth of the burn wound.
- **Medications :**
  - a. Tetanus vaccine or immunoglobulin.
  - b. Antibiotics: better to use broad spectrum antibiotics.
  - c. Analgesics: IV morphine to avoid neurogenic shock.
  - d. Anti-ulcer measures in the form of antacids to protect against the development of "Curling's" ulcer.

### III. Fluid Therapy

➔ According to **parkland formula** (commonly used)

1- **Amount:** 4 ml / % of burnt area from TBSA / kg body wt.

1<sup>st</sup> day:

|                          |                                |
|--------------------------|--------------------------------|
| 1st 8 hrs ½ total amount |                                |
| 2nd 8 hrs ¼ amount       | 3 <sup>rd</sup> 8 hrs ¼ amount |

2<sup>nd</sup> day:

· give ½ dose in the 1<sup>st</sup> day  
· +  
· 0.5 cc colloid / kg / %burn area

2- **Rate :**

50 – 70 cc/hr

➔ **Other Formula**

▪ **Evan's formula:**

- 1<sup>st</sup> day: 1 ml/kg/% burnt area saline + 1 ml/kg/% burnt area colloid
- 2<sup>nd</sup> day: 0.5 ml/kg/% burnt area saline + 0.5 ml/kg/% burnt area colloid

3- **Types of fluids**

- 1- Crystalloids : saline or ringer lactate
- 2- colloids : ½ crystalloids + ½ colloids especially in deep burns.

4- **Route :**

- a- In burns < 20% TBSA (adults) or < 10% TBSA (children), fluid therapy can be given by the oral route.
- b- In burns that are 20 – 30% TBSA, the oral route is supplemented by IV fluids.
- c- In burns > 30% TBSA, fluid therapy is given via the IV route.

- 1- In all types of formula, the daily caloric needs should be provided by administration of 2000 ml of glucose 5%.
- 2- In all types of formula, the maximum percentage of burn calculated is 50% to avoid serious over infusion.
- 3- Administration of blood can be started after 48 hours guided by hematocrit value.
- 4- IV antibiotics: Prophylactic systemic antibiotics (3rd generation cephalosporins + aminoglycosides + Metronidazole).
- 5- Crystalloids better to be avoided in full thickness burn where capillary membrane is damaged → saline infusion → extravascular space → ↓ IV value → aggravate hypovolemic shock
- 6- Oral intake is avoided during the first 48 hours to avoid gastrointestinal complications and is started gradually after that.

### ➡ **Nutrition**

- It shouldn't be neglected.
- Patients who have extensive burns are liable to have a serious catabolic status due to the combined effects of anorexia, extensive water and consequently caloric losses and due to sepsis, if present.
- Introduction of intravenous hyperalimentation has made it easy to correct this problem and to support the patient nutritionally during the critical period.

## **IV. Local treatment of major burn**

**The aim is to avoid infection**

- 1- Escharotomy: is circumferential burns in limbs and chest, the constricting eschars (adherent necrotic tissue) have to be released immediately.
- 2- Fasciotomy: in deeper burns may be limb salvage.
- 3- Cleaning and removing loose skin and initial conservative debridement.
- 4- Topical antimicrobial agents:
  - The ideal should be in water soluble base, not painful, not allergic, not toxic and bactericidal.
  - The 3 most commonly used are silver sulphadiazine, silver nitrate solution and mafenide acetate.
- 5- After application of local cream, the wound is managed by either exposure method or by occlusive method.

|                    | Open method                                                                                                | Closed method                                                                                                                             |
|--------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Definition</b>  | The wound is managed by leaving it exposed under complete aseptic precautions                              | The wound is covered by bulky occlusive dressing changed every 2-3 days                                                                   |
| <b>Indications</b> | 1- Burns of face, neck, perineum<br>2- Burns involving one side of trunk                                   | 1- Circumferentially burns.<br>2- Limbs to prevent stiffness and adhesions.                                                               |
| <b>Advantages</b>  | 1- More comfortable to patients.<br>2- Avoid repeated dressing.<br>3- Decrease anaerobic bacterial growth. | 1- ↓ cross infection.<br>2- ↓ fluid loss by evaporation.<br>3- ↓ pain by covering exposed nerves.<br>4- ↓ Edema of tissues by compression |

### ➡ **OPTIONS IN TREATMENT OF DEEP BURNS:**

#### **1- Autologous skin grafting :**

- ▶ Partial thickness skin grafts (Thiersch grafts) are commonly used to cover the large raw areas produced by burns.
- ▶ A graft is applied after either spontaneous separation of eschar (3-4 weeks) or early burn wound excision.
- ▶ Early burn wound excision is the preferred method for deep burns of the hand.



- ▶ Patients are usually subjected to surgery 3-5 days post burn (before bacterial infection sets in), where tangential excision of the damaged dermis is carried on.
- ▶ When healthy bleeding tissues are reached a skin graft is applied.

## 2- Biological dressings:

- ▶ In case where autografts are not enough, or the local wound condition is not favourable, it will render the wound less painful, minimize fluid & protein loss and control infection.
- ▶ Examples of biological dressing are allografts (cadaver's skin), xenograft skin (pig's skin) and amniotic membrane.
- ▶ More recently artificial skin substitutes are used with promising results. All biological dressings are only applied after removal of eschar and are changed every 3-4 days.
- ▶ It is to be stressed that biological dressings are only temporary and that permanent closure can be achieved only by autograft skin.

### ➔ Indications for hospitalization:

1. Major burns.
2. Minor burns which are:
  - a. Full thickness burn.
  - b. In critical area e.g. face, neck (may need urgent tracheostomy), hand and perineum.
  - c. Circumferential chest or limb burn (may need escharotomy).
3. Special types of burn:
 

|                     |                     |
|---------------------|---------------------|
| a. Electrical burn. | b. Inhalation burn. |
|---------------------|---------------------|
4. Special group of patients:
 

|              |                         |
|--------------|-------------------------|
| a. Very old. | b. Associated injuries. |
|--------------|-------------------------|

## Prognosis of burns

### 1. Burn factors:

- a. **Extent:** this is the most important factor. Mortality is about 50% if the extent of burn is 50%.
- b. **Depth:** Deeper burns carry higher mortality and more disfigurement.
- c. **Site:** Burns of the face are the worst because they are likely to be accompanied by inhalation burns of the respiratory tract.
- d. **Infection:** Septicemia is the major killer of burn victims.
- e. **Type:** High voltage electric burns are the worst. They are usually fatal. Scalds with boiling water commonly cause superficial burns and are the least harmful.
- f. **Associated injuries.**

### 2. Patient factors:

- a. **Age:** e.g. extremes of age have worst prognosis.
- b. **Concomitant diseases:** e.g. diabetes and coronary heart disease.

### 3. Treatment factors:

- Treatment in specialized centers has better prognosis.

## Thermal burn

- ## Inhalation injury

b. Suspected when:

- ### C. Treatment:

- ## Electrical burn

### b. Mechanism

- ### c. Effect

1. Muscle damage
2. ARF due to myoglobinuria
3. Cardiac arrhythmia & Respiratory arrest
4. CNS injury (affecting vital centers)
5. Cataract
6. Bone fracture due to sustained contraction.

**➡ Non-release phenomenon:**

- When victim became in contact with alternating current causing sustained tetanic contraction of the muscles which can't be released unless the electric source is shut off.

**Chemical burn****a. Types**

- Acid or alkali

**b. Mechanism**

- Acid → Coagulative necrosis (superficial)
- Alkali → Liquefactive necrosis (deep)

Chemical burns are better irrigated with water rather than neutralization of their effect by the opposite caustics which may damage the tissue

**Radiation Burn**

- Injury depends on dose, wave length & frequency.

**► Types**

- **Long wave length radiation** e.g. microwave → superficial skin burn with minimal effect due to less penetration of tissues.
- **Short wave length** e.g. X-ray → severe tissue damage due to release of free radicals

# Principles of skin coverage

## 1- Skin Grafts

### Definition

- It is segment of epidermis & dermis that has been completely departed (cut) from its blood supply & donor site → transferred into a recipient site (skin loss)

► **Types:** split, full thickness

► **Split:** Trunk, Thigh, ↑Take, ↑Trauma

► **Full thickness:** Full dermis, Face, Foot, For good cosmesis & sensation

### Types

- 1- Split thickness graft (**Thiersch graft**)
- 2- Full thickness graft (**Wolfe graft**)

### Steps

1. Separation of the required segment by surgical knife (dermatome)
2. The recipient area should be surgically clear & has formed granulation tissue (capable to regenerate due to adequate blood supply)
3. **After application of the graft:** The process of (**TAKE**) takes place which aims at nutrition of the graft by:
  - Imbibition of plasma (48 hrs) from newly blood vessels
  - Vascularization (after wards)
4. **Healing of donor site:** depends on the degree of thickness split or full.



|                    | Split thickness                                                                                                                                                                      | Full thickness                                                                                                                            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Definition</b>  | Epidermis + superficial part of dermis                                                                                                                                               | Epidermis + full thickness of dermis                                                                                                      |
| <b>Indications</b> | 1- Covering large area of granulation tissue.<br>2- Coverage after:<br>a) Deep burn.<br>b) Malignant tumor resection.                                                                | 1- Facial wounds<br>2- Palmar aspect of hands and plantar aspect of feet.<br>3- Site of pressure on sole of the foot                      |
| <b>Donor sites</b> | 1- Trunk, thighs<br>2- Upper arm, forearm                                                                                                                                            | 1- Post-auricular skin<br>2- Upper eye lid<br>3- Supraclavicular                                                                          |
| <b>Advantages</b>  | 1- Early separation & application.<br>2- Increase TAKE by graft.<br>3- Can cover wide area.<br>4- Early detection of recurrence of malignancy.<br>5- Donor site heals spontaneously. | 1- Direct closure of donor site.<br>2- Minimal contraction.<br>3- Better sensation.<br>4- Cosmetically better.<br>5- Resistant to trauma. |



|                      |                                                                                                                                                 |                                                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Disadvantages</b> | 1- More liable contraction.<br>2- More liable for pigmentation.<br>3- Weak resistance to trauma.<br>4- Poor sensation.<br>5- Cosmetically poor. | 1- Limited donor site.<br>2- Favourable granulation tissue.<br>3- Less TAKE.<br>4- Asepsis must be perfect.<br>5- Scar at the donor site. |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|

- ✓ Healing in split thickness graft occurs according to the degree of thickness
- Minimal → 1 week
  - Intermediate → 2 weeks
  - Thick → >2 weeks

#### **Whenever you take skin graft**

The following points should be put into consideration:

- 1- Healing by 1ry or 2ry intention
- 2- Color of the graft.
- 3- Skin appendages (hair follicle, sweat glands, sebaceous glands)
- 4- Sensation of the graft.
- 5- Durability of the graft.
- 6- Growth of the graft.

#### **Graft survival**

- Phase I (24 – 48 hours) → plasmatic imbibition.
- Phase II (2 – 4 days) → insoculation → Recipient bed capillaries align with those of the graft.
- Phase III (5 – 7 days) → Revascularization → anastomosis & neovascularization → it needs immobilization of the graft with mild compression.
- ▶ The thinner the graft, the faster is the take.
- ▶ Bare bone, bare cartilage & bare tendon are all bad recipient sites for grafts (poorly vascularized), a flap is better applied.

## 2- Flaps

### Definition

- Tissues to be transferred from one site of body to another one with their blood supply.

### Indications

- Wound with poor vascular bed (e.g. overlying bare bone, bare cartilage, bare tendons)
- Reconstruction of facial features.
- When sensation is required.

### Types

#### I- Skin flaps

- Can be classified into:

##### **A- Local flaps:**

##### ▪ **Random pattern flaps:**

- These flaps have no anatomically recognized blood supply. Thus, they should have strict length to width ratio in order to survive.
- A safe random pattern flap has a length to width ratio of 2;1 maximally.

##### ▪ **Axial pattern flaps:**

- These flaps are supplied by known arteries, and have no limitations regarding length to width ratio.
- Adjacent nerves can be included, and the flap can be a sensory one.
- Axial flaps may retain their attachment to the donor area and are termed **pedicled flaps**.
- If they retain their blood supply without the skin attachment, they are termed **island flaps**

##### **B- Distant pedicled flaps:**

- Distant → a flap needed to remote site from donor site e.g. from L.L. to U.L.
- Pedicled → blood supply reaches through a pedicle which needs to be cut after neovascularization.

- **Indications:** wounds (with ↓ vascularity, in the face), sensation is required
- **Class.:** skin flaps (local, distant)
- **advantages:** cosmesis, vascularity, carrier

#### II- Musculocutaneous (myocutaneous) flaps

- These are axial flaps that receive their blood supply from the underlying muscles through perforator vessels.
- The muscle is lifted from its bed with the overlying fascia and area of skin.
- The incorporation of the pedicled muscle in the flap enhances the survival of the cutaneous component.
- Famous examples are the latissimus dorsi myocutaneous flap that is used to cover wide defects resulting from wide radical mastectomies, and the other example is pectoralis major myocutaneous flap used to cover defects in the neck or face.

#### III- Fasciocutaneous flaps

- They have the same principles as the previous one, but their blood supply is through fasciocutaneous perforators.

#### IV- Microvascular free flaps

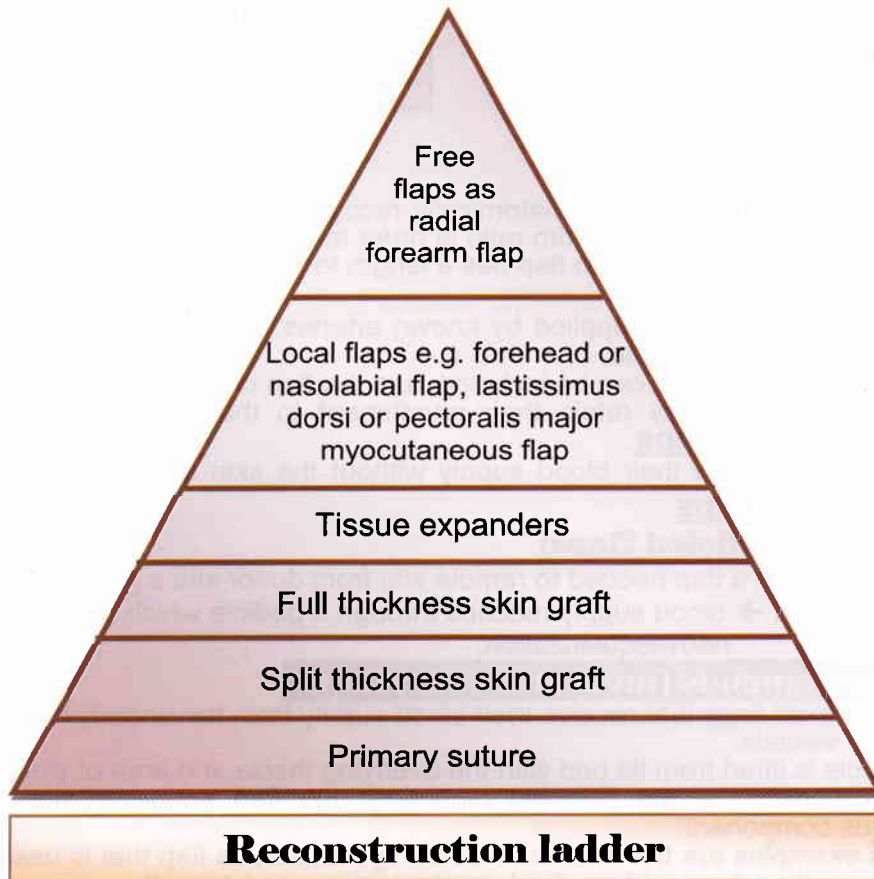
- It is now possible to anastomose vessels of less than 1 mm in diameter.

### Advantages of flaps

- 1- Good color & texture matching
- 2- Provide extravascular supply & sensation
- 3- Allow for future operation on the same area
- 4- can be used on a carrier for bone, muscle, skin

### 3- Tissue expanders

- Tissue expanders are inflatable silicone implants.
- They are placed subcutaneously in collapsed state.
- Over several weeks the expander is gradually inflated with saline through a subcutaneous port.
- The overlying skin is gradually stretched to accommodate a larger area.
- Finally, the expanded skin can be used to cover defects and the tissue expander is removed.



## Aesthetic surgery

### Definition

- Surgery to improve appearance for correction of any disfigurement.

### Patient selection

- It is very important as there is no pathology to correct, but rather an improvement in the body image is asked for.

### Examples

1. Rhinoplasty.
2. Face lifting.
3. Eyelid surgery.
4. Breast surgery (augmentation or reduction mammoplasty).
5. Liposuction (body sculpting surgery):
  - Special cannula with 1 cm incision → connected to high vacuum machine → aspirate excess fat from abdomen, buttocks or trochanteric areas.
  - Autologous fat injection → aspirated fat is reinjected to augment other areas.

## Bed sores (Pressure ulcers)

### Definition

- A localized area of soft tissue injury resulting from compression between a hard prominence & an external surface. It is a type of avascular necrosis.

### Pathology

#### STAGES:

- I → Non – blanchable erythema.
- II → Partial thickness skin loss "epidermis".  
Manifested as: abrasion, blister, shallow crater.
- III → Full thickness skin loss.  
SC tissue is exposed (damage or necrosis of SC tissue).
- IV → Muscles or bones are exposed  
Tissue necrosis of any supporting structure (muscle – bone – tendon – joint capsule).



**Stage I**



**Stage II**



**Stage III**

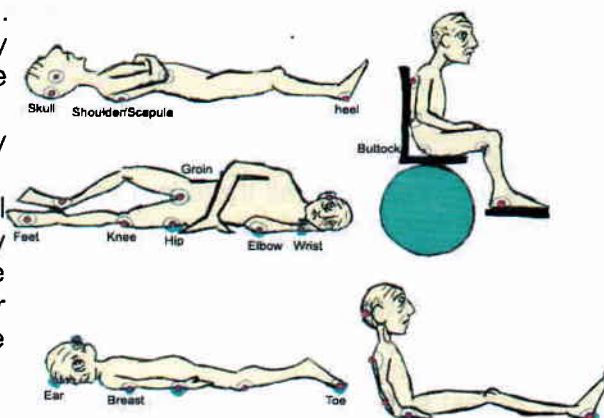


**Stage IV**



### ➔ SITES:

- 1) Common anatomical pressure points.
- 2) Positional pressure points: by abnormal position of the limbs or the body.
- 3) Instrumental pressure points e.g. by bed rails.
- 4) Internal viscera exposed to unusual pressure e.g. trachea pressed by balloon of endotracheal tube (especially if a ryle is present) or severely distended colon in Ogilvie syndrome.



### Etiology

1. Prolonged recumbency.
2. Warmth & moisture of skin (soiling by urine, stool, wet sheets or even generalized or local edema).
3. Shear forces: during manipulation & positioning e.g. rolling of the patient in bed.
4. Bad general condition: e.g. pneumonia, malnutrition or electrolyte imbalance.

### Diagnosis

- ➔ Frequent inspection of pressure points in high risk patients for early non-blanchable erythema (stage I).

### Complications

- a) **General:** Bacteremia, septicemia, toxemia.
- b) **Local:** Osteomyelitis, cellulitis, pyoarthrosis.

### Treatment

#### **A. PROPHYLAXIS:** (Most important)

1. Reposition every 2 hours.
2. Pressure reducing mattresses.
3. Skin care & improve general condition.

#### **B. DEFINITIVE TREATMENT:**

- ▣ **Stage I:** as prophylaxis, more frequent turning of the patient.
- ▣ **Stage II:** as I + dressing to prevent dryness of the wound for better healing.
- ▣ **Stage III & IV:** Debridement:
  - 1) Chemical (small wounds): saline dressing + collagenase (Iruzol).
  - 2) Surgical (large wound): may require myocutaneous flap.

# Skin & Subcutaneous Tissue

## A- Benign skin lesions:

1. Sebaceous cyst.
2. Dermoid cyst.
3. Callosity.
4. Corn.
5. Wart.
6. Papilloma.
7. Keratoacanthoma.
8. Congenital vascular anomalies.
9. Lipoma.
10. Neurofibromatosis.
11. Benign lesions of melanocytes. (Naevi)

## B- Precancerous skin lesions:

- 1- Squamous keratosis.
- 2- Bowen's disease.
- 3- Xeroderma pigmentosa

## C- Malignant skin Lesions:

- 1- Basal cell carcinoma.
- 2- Squamous cell carcinoma.
- 3- Malignant melanoma.

## A. Benign Skin Lesions

### 1- Sebaceous Cyst (Epidermoid Cyst)

#### Definition

- Retention cyst of sebaceous gland.

#### Etiology

- Acquired cyst caused by:
  - Obstruction of sebaceous gland duct by inspissated sebum-Drills- scarring.
  - Result in: Retention of sebaceous secretion into sebaceous gland.

#### Pathology

#### SITES

- Anywhere in the skin related to hair (scalp, axilla & groin).
- *Never in palms and sole "No sebaceous glands"*

#### MACROSCOPIC

- Cystic swelling attached to skin at a point "Punctum"
- Contains: semisolid, greasy sebaceous, material with bad odour.

#### MICROSCOPIC

- A true cyst: lined by flat squamous epithelium.

#### Diagnosis

#### → CLINICAL PICTURE:

- Age: (rarely before adolescence)
- Complaint: a slowly growing painless subcutaneous swelling.
- Signs:
  - It is well defined, small, tense, cystic swelling, indentable, non-compressible (to differentiate between it & hemangioma).
  - Attached to the skin at one point which is the site of the duct (punctum) "black spot"

- ▶ C/P: painless swelling, punctum, sebum
- ▶ Comp.: cyst + horn + cock's peculiar t.
- ▶ D.D.: dermoid cyst
- ▶ Invest.: C&S + FBS in recurrent infection
- ▶ TTT: excision + ttt of comp.

- On squeezing it discharges sebum.
- It is slowly growing, may attain large size and may be solitary or multiple.

**NB.** If inflamed → ↑size, tender, fixed to deep structures

## Complications

As any cyst

- 1- Commonest → infection and suppuration
- 2- Sebaceous horn → dried → inspissated sebum. Protrude from the punctum over the skin.
- 3- Cock's peculiar tumor (very rare) → (ulceration of sebaceous horn)
- 4- Local alopecia: due to stretch of the skin for long time.

**NB.** Simulate squamous cell carcinoma but base is not indurated



Cock's peculiar tumor



Sebaceous horn in

## DD

- 1- Dermoid cyst
- 2- Cock's peculiar tumor (SCC. BSC)

|                    | Sebaceous cyst                                          | Dermoid cyst               |
|--------------------|---------------------------------------------------------|----------------------------|
| <b>Age</b>         | After adolescence                                       | At childhood               |
| <b>Site</b>        | Related to hairy skin                                   | Related to lines of fusion |
| <b>Consistency</b> | Tense cystic                                            | Lax cystic                 |
| <b>Skin</b>        | Attached to skin by punctum where sebum can be squeezed | Not attached to skin       |

## Investigations

- Not important. It is a clinical diagnosis.
- May be needed with complications:
  - 1- Biopsy: in cock's peculiar tumor.
  - 2- Culture and sensitivity with recurrent infection.
  - 3- Fasting blood sugar with recurrence of infection in spite of adequate treatment

## Treatment

- 1- Uncomplicated → excision through an elliptical incision to include the punctum.
- 2- Infected → Incision and drainage
  - After inflammation subsides → excision

**Multiple cysts of the scrotum → excision of the skin bearing the cysts**

## 2- Dermoid Cyst

### Types

- 1- Sequestration dermoid cyst.
- 2- Implantation dermoid cyst.
  - Epidermoid cyst.
- 3- Tubulodermoid cyst:
  - Thyroglossal cyst.
  - Branchial cyst.
- 4- Teratomatous dermoid cyst of the ovary and testis (sacroccocygeal tumor).
- 5- Inclusion dermoid.

### 1) Sequestration Dermoid Cyst

#### Definition

- A congenital true cyst lined by squamous epithelium.

- ▶ **Etiology:** cong. true cyst
- ▶ **C/P:** painless swelling (lax, not attached to skin)
- ▶ **Comp.:** cyst + intracranial comp.
- ▶ **Invest.:** skull x-ray
- ▶ **TTT:** excision + ttt of comp.

#### Etiology

- A congenital cyst.
- Caused by sequestered piece of epithelium in the subcutaneous tissue at a line of fusion of the body during fetal life but it appears later in life.

#### Pathology

#### SITE

- Along the lines of fusion:
  - 1- Face → external angular (commonest)
    - Internal angular
  - 2- Ear → post-auricular
    - Pre-auricular
  - 3- Neck → in midline
    - Sublingual or supramyelohyoid (in the floor of the mouth)
    - Inframylahyoid.
    - suprasternal
  - 4- Trunk → in midline

Never in a limb (develop from buds → no line of fusion)



External angular dermoid cyst

#### MACROSCOPIC

- Cystic swelling.
- Contains: yellowish greasy sebaceous material.

#### MICROSCOPIC

- Outer fibrous layers.
- Wall lined by stratified squamous epithelium.



## Diagnosis

### Clinical Picture

- **Age:** at childhood
- **Complaint:**
  - A slowly growing painless subcutaneous swelling related to the previously mentioned sites.
- **Signs:**
  - ⇒ **General:**
    - Other anomalies.
  - ⇒ **Local:**
    - It presents as well defined, globular, **lax**, cystic swelling which is **not attached to the skin**.
    - The underlying bone may be hollowed out.
    - There may be a **pedicle connecting the deep aspect of the cyst to dura matter**.

**External angular dermoid cysts lie on bone defect caused by constant pressure**

## Complications

**As any cyst** (Infection, rupture, hemorrhage, pressure)

- 1- Cerebral compression (very rare) → Dumble shaped or hourglass dermoid
- 2- Intracranial complication with the dura matter should be investigated by skull x-ray before excision to be sure the sutures are closed.
- 3- Recurrence after excision → if incompletely excised

## DD

*From sebaceous cyst*

## Investigations

- Skull x-ray → to exclude presence of bone defects (if present, we wait till it closes)

## Treatment

- 1- Uncomplicated:
  - Surgical excision (best lines of treatment)
  - In children with dermoid cyst in the scalp it is better to wait till closure of the skull sutures because some cysts may communicate with the dura.
- 2- Infected → incision and drainage followed by excision after inflammation subsides.

## II) Implantation Dermoid Cyst

### Definition

- Acquired dermoid cyst

### Etiology

- **Implantation of skin into subcutaneous tissue by:**
  - 1- Pricking wound on the tip of a finger as during sewing.
  - 2- Use of skin as graft in hernioplasty.

## Pathology

### SITE

- In a tip of finger.
- Related to scar traumatic or surgical.

### MACROSCOPIC & MICROSCOPIC

- See before

## Diagnosis

### TYPE OF PATIENT

- Sewer or manual worker with a swelling related to tip of finger

### COMPLAINT

- Slowly growing swelling at 1st painless then painful

### SIGNS

- They are small & tense cystic swellings.
- The overlying skin is sometimes scarred.
- It may be tender due to compression on nerve endings at pulp of fingers.



## Complications and Treatment

- See before.

## III) Thyroglossal Cyst

- ➔ See general book (Thyroid part)

## IV) Branchial Cyst

### Embryology

- Normally the 2nd branchial arch grows rapidly covering the 3rd and 4th arches then fuse with the 5th arch
- Resulting in a space called (cervical sinus).

### Etiology

- Cervical sinus persists → branchial cyst.
- ± 2nd arch does not completely fuses with the 5th arch → congenital branchial fistula

- ▶ **Etiology:** persistent cervical sinus
- ▶ **C/P:** painless swelling + comp.
- ▶ **Comp.:** cyst, fistula(cong.), cancer
- ▶ **Invest.:** U/S ± fistulogram
- ▶ **TTT:** total surgical excision  
stepladder op. for fistula

## Pathology

### SITE

- Upper part of the neck.
- Related to carotid triangle.
- Partially deep to sternomastoid muscle protruding beneath its anterior border.

### MACROSCOPIC

- A cyst with a fibrous cord passing between external and internal carotids
- Connect cyst to pharynx "end above tonsil".

**The track extend up to side wall of nasopharynx "fossa of Rosenmuller"**

**MICROSCOPIC**

- Lined by squamous epithelium.
- Contain mucoid substance rich in cholesterol (rectangular crystals with one missing angle)
- Rich in lymphoid tissue so it is liable to infection.

**DD**

- **Cysts rich in cholesterol:**
  - Branchial cyst.
  - Spermatocoele.
  - Dental-dentigerous cyst.
  - Primary vaginal hydrocele.

**Clinical Picture****AGE**

- Although congenital, it appears at the age of 20 years

**COMPLAINT**

- A slowly growing painless swelling at lateral side of the upper part of the neck

**SIGNS**

- **General:**
  - FAHM if infected swelling developed.
- **Local:**
  - **Site:** protrude beneath the anterior border of upper 1/3 of sternomastoid muscle
  - **Shape:** rounded or oval
  - **Surface:** smooth
  - **Edge:** well defined
  - **Consistency:** tense
  - May be pulsating, compressible
  - **Skin overlying:** normal
  - **Special signs:** on it bulges out.

**Complications***As any cyst*

1. Infection: is the commonest
2. Acquired branchial fistula due to rupture, incomplete excision or incomplete incision of the abscess,
  - Fistula appears at anterior border of lower third of sternomastoid muscle it is crescentic in shape, discharging mucoid material or pus if infected.
3. Adenocarcinoma: very rare ☑

**Branchial fistula may be**

**DD****Swelling at lateral side of the neck**

- 1- Cold abscess (TB C/P)
- 2- Cyst in a thyroid lobe.
- 3- Laryngocele, pneumatocele.
- 4- Carotid artery aneurysm.
- 5- Fistula with TB sinus.

**Investigations**

- **If fistula** → fistulogram.
- **If cyst:**
  - **U/S:**
    - Ensure the diagnosis.
    - Exclude DD as cold abscess.
  - **Discharge** → Ziehl Neelsen stain
    - Characteristic rectangular cholesterol crystals with missing angles.
  - **Routine preoperative.**

**Branchial fistula****DD**

- |                             |                               |
|-----------------------------|-------------------------------|
| 1. Branchial cyst           | 2. Cold abscess               |
| 3. Cyst in thyroid lobe     | 4. Laryngocele & pneumatocele |
| 5. Carotid artery aneurysm. |                               |

**Treatment**

- **Cyst:**
  - Complete excision through transverse neck incision.
- **Fistula:**
  - Excision through multiple transverse neck incisions to remove the whole tract (Step ladder operation).
  - Ureteric catheter may be introduced in the track to facilitate the operation.

**V) Teratomatous dermoids**

- These are benign forms of teratomas.
- The cyst is lined by squamous epithelium but contains teeth, hair, bone or cartilage.
- They occur most commonly in the ovary but may be found in the testis or posterior mediastinum.

**VI) Inclusion dermoids**

- These are due to inclusion of the epidermis during closure of a cavity.
- They include sublingual, suprasternal, intracranial and intraspinal dermoids



### 3- Callosities

- It is an overgrowth of the epidermis with thickness of the horny layer.

**Cause** Prolonged friction or pressure

**Clinical picture** It appears as a horny yellowish plaque

**Treatment** Shaving + painting with salicylic acid and ether.

### 4- Corn

**Cause**

- Improper treatment of a callosity

**Clinical picture**

- It may be hard or soft. The central down-growth of a hard horny plug of epithelial cells into the dermis causing pain due to pressure on sensory nerve endings

**Treatment**

- Paint with 20% salicylic acid in collodiun
- Excision (rare)

### 5- Warts "Verrucae vulgaris"

**Cause** Filterable virus

**Site** Common in the hands and soles of the feet. It can occur in any part of the body.

**Clinical picture** Small, horny with irregular surface, usually multiple

**Treatment**

- 1-Chemical paintings with glacial acetic acid
- 2-Electric cautery under local anesthesia
- 3-Surgical excision.

### 6- Papilloma (Pedunculated papillomas "skin tags")

- It consists of central axis of connective tissue, blood vessels and lymphatics, surrounded by epithelium (squamous, transitional, cuboidal or columnar according to the site)

**Common sites**

- skin, kidney, colon, tongue and lips

**Complications**

- Malignant changes
- Bleeding (hematuria, bleeding per rectum, nipple discharge)

**Treatment**

- Excision, cryosurgery or cautery

## 7- Molluscum sebaceum (keratoacanthosis)

### Definition

- It is keratinizing squamous cells which resolves spontaneously.

### Incidence

- Middle age ♂ = ♀.

### Etiology

- Prolonged exposure to sun.

### Pathology

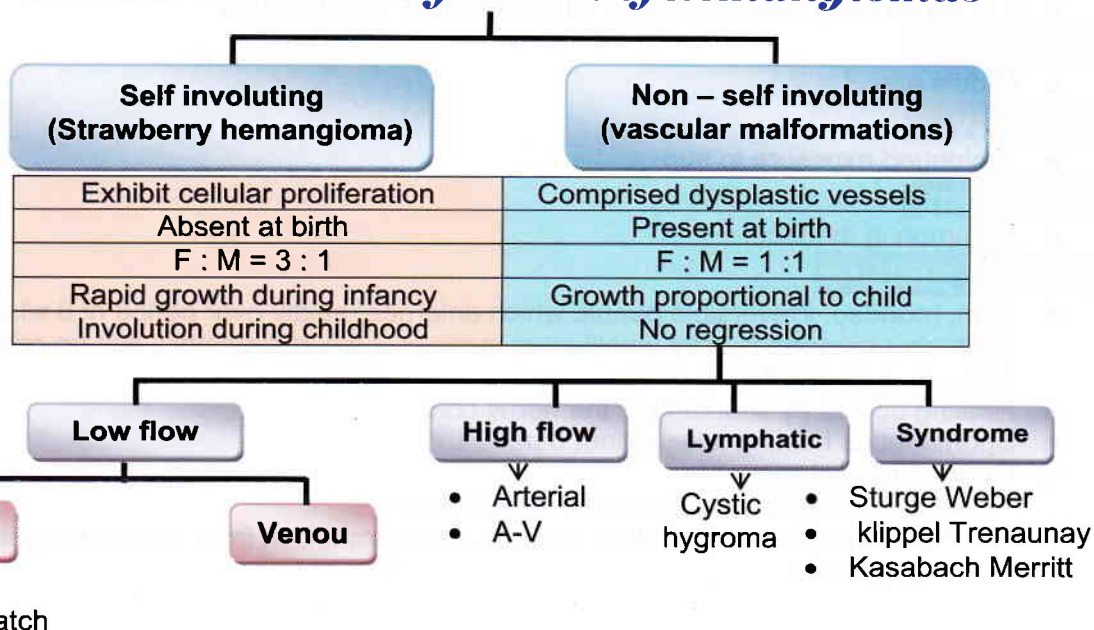
- Common in the face.

### Clinical picture

- Firm, rounded, irreversible papule which enlarges rapidly over period of 8 wks. → producing rounded slightly umbilicated mass (< 2 cm in diameter), can be containing horny plug covered by a crust.
- Healing occurs by shedding of the horny core.
- Spontaneous healing takes about 6 m.
- **Clinical importance:**
  - It mimics an epithelioma /or rodent ulcer.
  - Pathological examination: reveals abrupt transition from normal to hyperplastic epithelium.

## 8- Congenital Vascular anomalies

### *Mullkin et al. classification of hemangiomas*



### i- Self involuting hemangiomas

#### Hemangioma (strawberry hemangioma)

##### Definition

- Benign tumor of endothelial cells of capillaries.

##### Incidence

- Most common & most rapidly growing tumor in infancy.
- 70% are present at birth and 30% appear within the 1st year of life.
- Female : Male = 3 : 1
- 10% of white infants.

##### Pathology

- Site:** Anybody surface but the most common site is face.
- The lesion usually presents by the following 3 stages:**
  - Stage of proliferation** short after birth a pale or reddish patch and increases in size over 6 months.

- Incid.:** commonest benign tumor in infancy, (♀: ♂=3:1)
- C/P:** patch ↑, →, ↓ in size
- Comp.:** site dependant
- TTT:** mainly reassurance

**2. Involution phase:**

- Usually starts at the end of first year, central pallor appears and the color of the lesion slowly fades.
- There is progressive decrease in the size of the lesion. This stage continues till the age of 10 years.

70% regress after 7 years of age, 5% regress after 5 years of age

- 3. Involved phase:** The skin finally is normal in 50% of patients. Some residual skin changes as discoloration, scarring, telangiectasia may present.

**Clinical picture**

- Lesion start as erythematous raised patch with irregular surface
- During the 1<sup>st</sup> 2-3 wks after birth
- grows stationary for 2-3 yrs
- Then spontaneous regression starts & completed by age of 5-7 yrs.

**Complication**

According to the site

1. In the face → Squint.
2. In the eye lid → ↓ visual field → amblyopia + blindness.
3. Ulceration is a common complication.
4. Bleeding is not common.
5. Infection .
6. Airway obstruction.
7. Large visceral haemangioma may entrap platelets leading to thrombocytopenia.
8. Large visceral or cutaneous haemangioma may lead to congestive heart failure.

**Treatment****1. Conservative:**

- Reassurance of patients & observation till spontaneous involution (cosmetically better than excision scar)

**2. Indications of non-conservative treatment:**

- a. Lesions obstructing airways.
- b. Lesions interfere with vision.

**► Modes of treatment:**

- 1) Corticosteroids.
- 2) Laser photocoagulation.
- 3) Surgical treatment.



## ii- Non - self involuting hemangiomas

### I- Low flow Malformations

#### A. Capillary malformations

##### **I- Portwine stain (Naevus flammeus)**

- Commonest type of vascular malformation
- The lesion is present since birth and it doesn't undergo involution.
- The lesion is dark purple in color and it doesn't raise above the surface. Pressure causes blanching but the color returns immediately after release of pressure.
- Sometimes the lesion takes the distribution of one of the branches of trigeminal nerve, but the lesion doesn't cross midline.
- Sometimes a portwine stain of the face is associated with similar lesions in the meninges → **Sturge Weber Syndrome:**



- 1) Lepto-meningial A-V malformation overlying sensory or motor areas.
- 2) Gigantism seen in middle finger, left thumb, scrotum, lower limb.
- 3) Portwine stain with trigeminal distribution.

##### ➡ Treatment :

- a. Pulsed dye laser is the treatment of choice during childhood. Requires general anaesthesia and multiple sessions may be needed.
- b. YAG laser is the treatment during adulthood. Results are not as favorable as children.

### **II- Salmon Patch**

- Nearly half of all babies have salmon patch.
- Appear as pink, flat marks on the forehead, back of the neck or on the lip.
- The skin is not thickened.
- Usually covered by hair and out of sight (at the back of neck).



## B. Venous Malformations

(Previously called cavernous hemangioma)

### Definition

- Multiple large inter communicating sinus ( vascular spaces)

### Incidence

- less common than capillary (portwine)

### Site

- External: Cheeks, lips Tongue, eye, ear extremities .....ect
- Internal: the commonest site is liver.

### Clinical picture

- 1- Present since birth / no spontaneous involution.
- 2- Compressible swelling with some discoloration of overlying skin.
- 3- Sign of emptying is very characteristic: Pressure causes blenching but colour returns immediately after release of pressure.
- 4- If in the liver → sequestration of platelets → thrombocytopenic purpra
- 5- Add clinical picture of the site ( tongue, lips , ear .....ect)

### Investigation

- 1- Arteriography: pre-operative : shows extent of the lesion ( both diagnostic & therapeutic).
- 2- CT Scan : to show extent of the lesion

### Treatment

- 1- Compression therapy may relieve pain and edema.
- 2- Percutaneous sclerosis may be performed with hypertonic saline or 100% alcohol. There is a high recurrence rate; multiple sessions may be required.
- 3- Surgical excision. Preoperative embolization or sclerosis facilitates intraoperative haemostasis.
- 4- Interstitial laser coagulation.

## II- High flow malformations

### I- Arterial (plexiform hemangioma) (Cersoid aneurysm)

#### Definition

- It is congenital A-V fistula.

#### Pathology

#### Site

- Usually in the scalp, especially in temporal region or occipital region may involve underlying bone (in relation to superficial temporal artery).

#### Macroscopic picture

- A bluish cystic swelling

#### Microscopic picture

- Consists of arteries and veins

#### Diagnosis

- Clinical picture

##### ▶ Complaint:

- ♦ Cosmetic disfigurement.
- ♦ Headache.

##### ▶ Signs:

##### ♦ General:

- Fever if inflamed
- Water hammer pulse.

##### ♦ Local:

- Inspection:
  - Irregular swelling at temporal region, with normal skin overlying.
- Palpation: pulsating compressible swelling.
- Auscultation: machinery murmur over it.

#### Complications

- 1) Hemorrhage (very dangerous as it's arterial).
- 2) Cosmetic disfigurement.
- 3) Infection.
- 4) Ulceration of skin overlying.
- 5) Degenerative changes e.g. calcification.

#### DD

- From other types of Hemangioma e.g. cavernous Hemangioma.

#### Investigations

- Doppler and duplex.
- External carotid angiography.
- X-Ray on the skull → shows rarefaction of the bone.

- ▶ C/P: swelling (disfigurement), headache, comp.
- ▶ Comp.: as cyst
- ▶ Invest.: Doppler, angiography
- ▶ TTT: excision

**Treatment**

Surgical TTT is very difficult d.t. presence of multiple feeding arteries

- Surgical excision with the following precautions:
  1. Semisitting position.
  2. General hypotensive anesthesia.
  3. Preoperative embolization.
  4. Temporary ligation of the external carotid artery.

**II- Arterio-Venous Malformation**

- Characterized by abnormal connections between arteries and veins without an intervening capillary bed.
- Present at birth but may not become evident until late childhood.
- It may be localized or diffuse.
- Localized AVM presents by a localized swelling with increase surface temperature. There may be palpable thrill or murmur.
- Generalized AVM growth disturbance or skeletal distortion.

**➔ Treatment :**

- a. Ligation or embolization feeding vessel often results in rapid enlargement of collateral vessels increasing the size of the lesion.
- b. Excision .Preoperative Angiography and embolization of feeding arteries followed by excision next day. Extensive coverage by a free flap may be needed.

**■ Klippel Trenaunay Syndrome**

- Port wine + 2ry various veins due to A-V malformation

**■ Hereditary hemorrhagic telangiectasia**

- Is an autosomal dominant disease characterized by multiple cutaneous, visceral an mucosal AVM

| <b>Hemangioma</b>                                                                                                                                                                                                                   | <b>Vascular malformation</b>                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>▪ Appears shortly after birth.</li> <li>▪ 3 stages:               <ul style="list-style-type: none"> <li>– Progressive.</li> <li>– Stationary.</li> <li>– Regressive.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>▪ Dated since birth.</li> <li>▪ Stationary or slowly progressive.</li> </ul> |



### III. Lymphatic Malformation

#### Cystic Hygroma (Cavernous Lymphangioma)

##### Definition

- Abnormally formed lymphatic channels

##### Etiology

- Diffuse lymphangioma it is a hamartoma rather than true tumor of lymphatic vessels.
- It is due to failure of sequestration of part of jugular lymph sac of fetus.

##### Pathology

##### SITE

- **Commonest sites** → root of the neck (superficial to sternomastoid M. & extends to posterior triangle)
- **Less common in** → lip (macrocheilia)  
→ tongue (macroglossia)  
→ axilla  
→ mediastinum  
→ groin

##### MICROSCOPIC

- Multiple intercommunicated lymph spaces lined by endothelial cells and contain lymph. Cysts near surface are large while deeper one are small and infiltrate muscle.

##### MACROSCOPIC

- Size → large
- Shape → irregular
- Edge → ill defined
- Color → translucent

##### Clinical Picture

##### TYPE OF PATIENT

- At birth or within first few years of life

##### SWELLING

- ↑ by: They often enlarge & become tender during periods of upper respiratory tract infection
- Number → single
- Site → lower part of posterior triangle
- Size → large
- Consistency → lax, cystic
- Surface → irregular
- Edge → ill defined
- Transillumination → **Translucent (the only translucent neck swelling)**
- Special character → **partially compressible, non-pulsating mass.**
- **Increase in size on coughing or crying.**

- ▶ **Etiology:** hamartoma
- ▶ **C/P:** lax cystic translucent partially compressible non-pulsating swelling
- ▶ **Comp.:** inf., resp. distress, obst. labour
- ▶ **TTT:** excision



**DD**

- Branchial cyst (deep to sternomastoid & anterior)

**Complication**

1. Obstructed labour.
2. Recurrent infection (rich in lymphatic).
3. Respiratory distress due to compression of trachea to induce fibrosis.

**Treatment**

**(Surgical excision is only potential curative treatment)**

- Surgical excision of the swelling at about the age of 3 years should be done.
- This could be facilitated by injection of boiling water in the swelling to introduce fibrosis to make it smaller
- **Complication of surgery:** injury to facial N.

| What | <b>Veous malformation</b> | <b>Lymphatic malformation</b>     |
|------|---------------------------|-----------------------------------|
| ↑    | High venous pressure      | Upper respiratory tract infection |
| ↓    | Compression               | Potentially compressible          |

## 9- Lipoma

### Definition

- It is a benign tumor arising from adipose tissue.

### Pathology

### Pathological (structural) Classification

#### ▣ **Lipoma is classified according to structure into:**

- Pure lipoma: mainly adipose tissue (non compressible).
- Fibrolipoma: with extensive fibrous tissue (firm).
- Hemangiolipoma or navio lipoma: with extensive vascular tissue (partially compressible as blood vessels are compressible while fat is not).
- Myxolipoma ( myxematous tissue)

- ▶ **Types:** commonest is s.c.
- ▶ **C/P:** swelling, pain, comp.
- ▶ **Comp.:** as cyst + liposarcoma
- ▶ **Invest.:** biopsy if needed, imaging if deep
- ▶ **TTT:** excision

### Gross picture

- ▣ **Size:** variable.
- ▣ **Shape:** oval or rounded.
- ▣ **Surface:** Lobulated.
- ▣ **Consistency:**
  - Always soft.
  - Except, Firm in → Fibrolipoma (due to fibrous tissue elements).
  - Subfascial lipoma (as it is under tension).
- ▣ **Color:** Yellowish.
- ▣ **Cutsection:** thin fibrous capsule sends fibrous tissue septa divide the tumor into multiple spaces.
- ▣ **Capsule:** 2 capsules:
  - ◆ Inner true: Formed of fibrous tissue.
  - ◆ Outer false: Formed by compressed surrounding structures.
  - ◆ Between the 2 capsules there is a line of cleavage that facilitates enucleation of the tumor.
  - ◆ Lipoma can be classified according to presence or absence of the capsule into: encapsulated or diffuse.
- ▣ **Origin:** adipose tissue.
- ▣ **Blood supply:** through the pedicle at one side of the tumor.
- ▣ **Number:**
  - Solitary well defined swelling .
  - Multiple lipomatosis is when the limbs or the trunk are the seat of multiple lipomas.
  - Diffuse lipomatous deposits: this can occur in certain areas e.g.: patient with myxedema has supraclavicular fatty deposits, elderly persons may develop lipomatous deposits below the chin and some times females may develop painful fatty deposits in the thigh (Dercum's disease)

### Microscopic Picture

- ▣ Aggregation of fat cells with signet ring appearance. separated by fibrous connective tissue stroma containing blood vessels arising from the pedicle.

## Clinical Picture

- It differs according to the site.

## Complaint

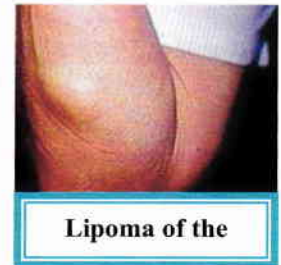
- Painless slowly growing swelling.
- Cosmetic disfigurement.
- Painful lipoma (neurolipoma, Decrum, Complicated lipoma)

## Signs

- General:** e.g. fever if lipoma is complicated by infection.
- Local:** According to site:

### 1) Subcutaneous lipoma

- The commonest type.
- Common in back, shoulder, buttocks, forehead and limbs.
- Lobulated painless mass **attached to** skin at multiple points.
- Soft** in consistency but may be firm if excess fibrous tissue in it. Sometimes may give pseudo-fluctuation due to high mobility of tumor in its bed and some degrees of fat liquefaction inside it.
- Has well defined **slippery edge** due to double capsule.
- May be solitary & multiple.
- May be pedunculated → lipoma arborescens
- Mobile over deep structures.



Lipoma of the

### 2) Subfascial lipoma

- Firm**
- Not attached to skin.**
- Doesn't have a slippery edge.**
- Occurs under deep fascia e.g. palmar or plantar fascia or in the areolar layer in the epicranial aponeurosis, difficult to diagnose.
- Increased incidence in forehead.

### 3) Sub synovial lipoma

- Beneath synovial membrane of the joint
- Rounded or oval swelling related to a joint with normal skin overlying.
- If around the knee it can be differentiated from baker's cyst by being constant in consistency whether the joint is flexed or extended.

### 4) Submucous lipoma

- Beneath mucous membrane of larynx → it may cause respiratory obstruction.
- Beneath mucous membrane of the intestine → it may cause intussusception.

### 5) Inter or intramuscular

- Swelling in or in between muscles, common in thigh, shoulder with normal skin overlying.
- It becomes more firm on muscle contraction.
- DD:** fibrosarcoma (hard & rapidly growing)

### 6) Subperiosteal lipoma

- Swelling in relation to long or flat bones.
- It is difficult to be differentiated from osteoma.



Endoscopic view of submucous lipoma of the intestine



**7) Extradural**

- ♦ Only in spinal cord, **never in the cranium as there is no fat.**
- ♦ Presented by pressure symptoms.

**8) Subserous lipoma**

- ♦ Beneath visceral or parietal peritoneum or pleura.

**9) Intraglandular lipoma**

- ♦ Inside the gland as parotid gland, thyroid gland and breast

**10) Retroperitoneal lipoma**

- ♦ Behind post. parietal peritoneum.

**11) Lipoma in the suprasternal area (Burn's space) (rare type)**

Diffuse lipomatosis "Dercum disease":

1. **Type of patient:** Female, usually post menopausal.
2. **Site:** Usually in lower limb.
3. **Characterized by** small, multiple swellings and painful.

**Complications****1. Dangerous types of lipoma:**

- Submucous lipoma: as it may cause respiratory obstruction or intussusceptions.
- Retroperitoneal: as it turn malignant.
- Some surgeons believe that liposarcoma is malignant from the start.
- Extradural lipoma: as it causes pressure manifestations in spinal cord only

**2. Infection.****3. Ulceration** of overlying skin and mucous membranes.**4. Degenerative changes**, liquefaction or calcification.**Investigations**■ **Specific:**

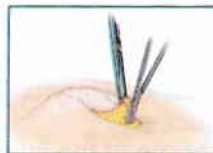
- Excisional biopsy.
- X-Ray: if Subperiosteal.
- CT spinal cord if it is extradural.

**DD**

- According to its site e.g. Subperiosteal should be differentiated from osteoma.

**Treatment**

- Surgical excision (Enucleation of tumor from its capsule) if:
  - Not accepted cosmetically.
  - Complicated.



Incision



Enucleation



Suturing

**Prognosis**

- Subcutaneous lipoma never to turn malignant, but in thighs and buttocks there is increased incidence of malignant transformation.
- Retroperitoneal lipoma: more liable to turn malignant.

**Oral Questions**

- Dercum disease
- Dangerous types of lipoma
- Painful lipoma (neurolipoma, Dercum, Complicated lipoma)

## 10- Neurofibroma

### Introduction

- neuron is formed of ( cell body, nerve axon, dendrites) → it is the functional unit of nervous system
- **Nerve axon is surrounded by Schwann cell which produce neurolemmal sheath**

- ▶ **Types:** commonest is generalized
- ▶ **C/P:** swelling + café au lait patches
- ▶ **Comp.:** pressure, neurofibrosarcoma
- ▶ **Invest.:** only in familial type
- ▶ **TTT:** excision

### Definition

- It is a tumor like masses formed from nerve sheaths either neurolemma (neurolemmoma) of spinal nerves or schwannoma from cranial nerves usually the 8<sup>th</sup> nerve.
- It is considered as hamartoma.

### Types

- 1- Generalized ( Von Reckling Hausen's disease)
- 2- Solitary.
- 3- Patchy dermatocoele (Plexiform neuroma).
- 4- Molluscum Fibrosum.
- 5- Elephantiasis neurofibromatosis.
- 6- Acoustic (8th nerve)

### Clinical Picture

#### Symptoms

- Patient usually presented with painless swelling that moves across and not along the nerves of gradual onset and slowly progressive course.

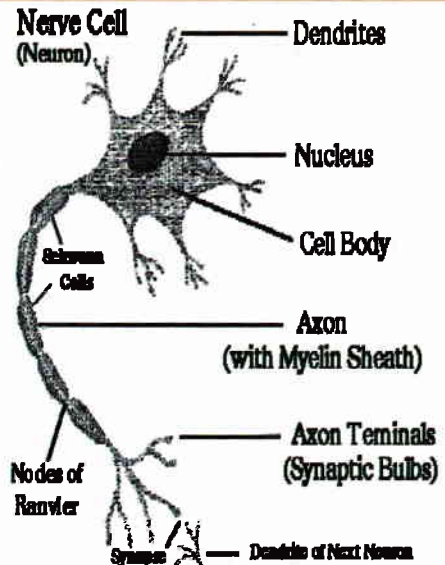
#### O/E

- **No. :** Solitary or multiple.
- **Size:** variable.
- **Shape:** rounded.
- **Site:** subcutaneous.
- **Edge:** well defined.
- **Consistency:** firm.
- **Mobility:** not attached to skin.
- **Cafe au lait patches:** brown patches seen all over the body.

#### → ACCORDING TO DIFFERENT TYPES:

#### 1- Generalized neurofibromatosis(Von Reckling Hausen's disease)

- The most common type
  - Often it is familial
  - No. : multiple
  - Size: variable
  - Consistency: firm.
  - Mobility: mobile across but not along the nerve.
  - Cafe au lait patches: especially on the back.



- Special characters: tender, ↑ ICT if arise from the intracrainal nerve, no sensory or motor loss.
- Pheochromocytoma may be present (MEN IIb).
- Malignant transformation is associated with pain , anesthesia , paralysis and progressive increase in the size of lesion.

## 2- Solitary neurofibroma

- **No.:** single.
- **Size:** variable.
- **Consistency:** firm, tender (due to compression of nearby nerve fibers-not infiltration).
- **Mobility:** across but not along the nerve
- **Cafe au lait patches.**

## 3- Pachy dermatocele(Plexiform Neuroma)

- Cystic swelling gives sensation as a bag of worms due to presence of multiple nerve fibers inside the swelling
- swelling is common in face → facial deformity

## 4- Molluscum fibrosum

- Soft fibrous swellings(cutaneous nerve endings are affected)
- Scalp, face and trunk are commonly affected (hand and feet escape).

## 5- Elephantiasis neurofibromatosis:

- Skin becomes thickened and replaced by grayish white glistening tissue (diffuse affection of the nerves of the skin and subcutaneous tissue).
- Commonly in children in limbs.
- Hypertrophy of a huge part of a limb.
- Differentiated from lymphedema by congenital nature & café au lait patches.

## 6- Acoustic neuroma:

- May be associated with acoustic nerve tumor.
- It has a striking familial incidence showing itself as Mendelian dominant trait.
- It is often associated with tumors of the dura and choroid plexus.

### Neurofibrosarcoma :

- ▣ Arise de novo or may develop by malignant transformation in a neurofibroma.
- ▣ It forms a painful rapidly growing tumor which invades the surrounding tissues producing anesthesia and paralysis and forms distant metastasis.
- ▣ Wide excision should be carried out in localized tumors, but amputation is indicated for extended tumors and post operative recurrence.

## Complications

- 1- Pressure symptoms e.g. deafness in acoustic neuroma.
- 2- Malignant transformation(neurofibrosarcoma):
  - Sudden change in behaviour :-pain -rapid growth-hard in consistency-never paralysis.

## D.D.

(Multiple swellings)

- |                                         |                      |
|-----------------------------------------|----------------------|
| 1. Multiple neurofibromatosis.          | 3. Multiple melanoma |
| 2. Multiple lipomatosis.                | 4. Multiple angioma. |
| 5. Multiple lymph node enlargement.     | 6. Multiple warts.   |
| 7. Multiple exostosis (bony swellings). |                      |

### Investigations

Mainly clinical diagnosis

- Search for associated conditions e.g. MENIIb (blood pressure-serum calcitonin-urinary catecholamines).

### Treatment

- Surgical excision is the treatment of choice

- **BUT**

1. Debulking of the lesion is necessary to improve self image of the patient.
2. With high rate of recurrence till age of puberty → repeated partial excision.
3. Patient with generalized neurofibromatosis → must be fully examined because they might have acoustic neuroma.

- Neurofibroma does not affect nerves except neurofibrosarcoma and acoustic neuroma.
- Familial neurofibroma: Von Reckling Hausen disease and MENIIb.



# 11- Benign Lesions of Melanocytes = Benign Melanoma (Naevus)

## Definition

- True neoplasm arising from melanocytes.
  - Melanocytes are pigmented cells that arise from neural crest and then migrate to lodge in between the basal cells of the epidermis
  - Its function is to form and transfer melanin pigment to adjoining keratocytes.

## Incidence

- Naevi are the most common tumors in humans.
- At birth 2.5% of children have pigmented skin lesions.

## Types

- ▶ **Types:** lentigo, junctional, compound, intradermal
- ▶ **TTT:** no ttt but excision if: cosmosis, liable for trauma / malignancy, giant hairy naevi

### 1. Lentigo

- Melanocytes replace the basal layer of epidermis in certain sites.
- **Histologically:** appear as rounded cells containing fine granular melanin pigment.
- **Clinically:** flat spot black or brown in color

### 2. Junctional pigmented naevus

- **Histologically:**
  - More proliferation of melanocytes → small nodules of epidermis that bulge downward in the dermis.
  - Naevi in younger are junctional, and most of them turn intradermal by adulthood.
- **Clinically:** like lentigo

### 3. Compound naevus

- **Histologically:**
  - The basement membrane is disrupted and some melanocytes pass to the dermis, these melanocytes lose their capacity to melanin and called naevus cells also the dermis contains some macrophages containing melanin pigment.
- **Clinically:**
  - Black or brown nodule raised above the surface of skin with some hair sometimes, it occupies large area → giant hairy naevus.

### 4. Intradermal

- **Histologically:**
  - Melanocytes are present mainly in the dermis with junctional activity in majority of cases.
- **Clinically:** like compound naevus.

#### ▶ Can pigmented naevus turn malignant?

- 1- Giant hairy pigmented naevi (commonest to turn malignant).
- 2- Junctional naevus.
- 3- If a site of repeated chronic irritation e.g. during shaving.

**Treatment**

- Majority of lesions require no treatment.
- Indications for surgical excision:
  - Cosmetic reasons
  - If subjected to repeated trauma.
  - If suspicion of malignant transformation.
- Giant hairy naevi must be excised as soon as possible.

**B. Precancerous Skin Lesions****1. Squamous keratosis  
(actinic / senile keratosis)**

- It is a dry rough inelastic irregular pigmented area of the skin.
- **Histology:**
  - Area of hyperkeratosis, nuclear polymorphism, ↑ mitotic figures.
  - Squamous keratosis is the most important precursor of invasive cell carcinoma.

**2. Bowen disease**

- Arises in non-exposed skin.
- It is sharply, demarcated, rounded, reddish patches which enlarges slowly.
- There is marked epidermal hyperplasia usually misdiagnosed as psoriasis.

**3. Xeroderma pigmentosa**

- AR.
- Deficient ability of DNA repair → Mutations impair certain oncogenes & tumor suppressor genes that may lead to predisposition to squamous & basal cell carcinoma.

## C. Malignant Skin Lesions

### 1. Basal Cell Carcinoma (Rodent ulcer)

#### Definition

- **Locally malignant** tumor from basal layer of the epidermis or from equivalent cells of hair follicles, sweat or sebaceous glands

- ▶ **Etiology:** as skin cancer "U.V. rays"
- ▶ **Path.:** face, nodule or ulcer, palisade app.
- ▶ **Spread:** only direct
- ▶ **C/P:** ♂ > 40 years with nodule, ulcer, LN
- ▶ **Comp.:** as cancer + baso-squamous carcinoma
- ▶ **Invest.:** clinical diagnosis + biopsy, X-ray
- ▶ **TTT:** surgical, irradiation

#### Incidence

- Age: > 40 years
- Sex: **Male** > Female
- Fair skinned patients

#### Predisposing factors

- Exposure to sun rays, **Ultra-violet rays (Most important)** so the disease is more common in Farmers & Sailors.(actinic or solar keratosis)
- **Predispose to multiple basal cell carcinoma all over the body:**
  - Ionizing radiation.
  - Patients receiving immunosuppressants.
  - **Premalignant Lesions**
    1. **Xeroderma pigmentosa:** extreme sensitivity to sunlight, progressive dryness of the skin, and malignant changes to BCC and SCC.
    2. **Keratoacanthoma:** fleshy, elevated, central hyperkeratosis, rapid growth and involution.
    3. **Actinic keratosis:** most common, sun exposed areas, multiple, well circumscribed.
    4. **Bowen's disease:** more common in elderly men, solitary, erythematous, scaly plaque (**Erythroplasia of Queyrat**).
    5. **Leukoplakia:** chronic inflammation of oral mucosa, it usually occurs in older men, who are smokers.

#### Pathology

#### Site

- 90% in the **face**
- Area above a line from lobule of the ear till angle of mouth, commonest sites are inner and outer canthi of eye and nasolabial fold.



#### Macroscopic Picture

##### A- Common types:

- 1- **Nodular form:** pearly white or blue translucent nodule with dilated capillaries over it (it is the earliest lesion). It is covered by thin epidermis. The nodule then ulcerates after sometime with serous discharge and bleeding. Healing sometimes occurs in one area of the lesion while further ulceration occurs.

**2- Ulcer form** (Rodent ulcer) → **the commonest 75%**

1. **Site** → In the face above line joining tragus with angle of mouth ( $> 90^\circ$ ).
2. **Shape** → Rounded, oval or irregular.
3. **Number** → usually single but may be multiple.
4. **Base** → Indurated, early mobile & late fixed.
5. **Floor** → red and granular and often covered with dry crust or scab.
6. **Edge** → Rolled in, beaded.
7. **Base** → early soft & late indurated.
8. **L.N.** → not enlarged (locally malignant)  
(If enlarged → infection or SCC change)
9. **Discharge** → blood or pus.

**3- Excavating type:** the ulcer erodes deeply into the underlying structures leading to destruction of the nose and infiltration of the nasal sinuses.

**Q:** Why edge of ulcer is rolled in and beaded?

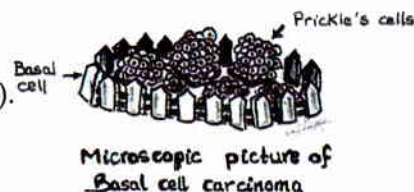
- **Raised and rolled in:** as the lesion becomes necrotic at its center but grows quite quickly at its periphery so that it raises above the surface of lesion
- **Beaded:** due to fibrosis which divide tumor edge into beads

**B- Uncommon types**

1. **Pigmented type (DD melanoma).**
2. **Cystic BCC**
3. **Flat superficial spreading BCC**
  - Presents as red scaly patch..
  - Resembles psoriasis or eczema..

**Microscopic**

- Rounded solid masses of cells (**pallisade appearance**).
  - Low columnar epithelium at periphery as (**basal cell**).
  - Polyhedral cells at center as (**Prickle's cells**)
- The masses are separated by fibrous tissue stroma.

**Spread**

- Only direct spread to surrounding (**Locally Malignant**)

**Clinical Picture**

- **Type of patient:**
  - ♂  $> 40$  years
  - Fair colored people
  - Farmers & sailors
- **Nodule:** Painless nodule → Ulcer resistant for treatment
- **Ulcer:**
  - Slowly growing but progressive.
  - Characters : as before (in pathology)
- **Lymph Nodes:**
  - Not enlarged except in:
    - 2ry infection → firm, tender and mobile.
    - Epitheliomatous transformation → stony hard, mobile but later fixed.

**Epitheliomatous transformation is suspected if:**

- 1) Growth becomes rapid
- 2) Edge become everted
- 3) LN becomes hard & fixed



### Differential Diagnosis

1. Ulcer of Squamous Cell Carcinoma (SCC).
2. Malignant melanoma.
3. Cock's peculiar tumor.
4. Septic granuloma.
5. Chancre.

### Complications

- Infiltration of the surrounding ( it may erode the underline skin)
- Secondary infection → meningitis and cavernous sinus thrombosis (Cause of death)
- Hemorrhage from erosion of big vessels.
- Epitheliomatous transformation (Baso-squamous carcinoma)

### Investigations

**It's mainly a clinical diagnosis by biopsy is mandatory to ensure diagnosis & exclude D.D.**

1. Biopsy (Excisional or incisional):
  - Malignant cells derived from prickle cell layer penetrating basement membrane in groups with peripheral pallisade appearance.
2. X-ray → To detect bony involvement (rodent ulcer).

### Treatment

#### A –Surgical (Main line)

##### ➡ Indications:

- a. Small lesions.
- b. Infiltration of the underlying cartilage or bone as bone cells will protect malignant cells from the effect of radiotherapy. Furthermore, radiotherapy can cause necrosis of the involved bone or cartilage.
- c. Radioresistant lesions.
- d. Recurrence after previous irradiation.
  1. Excision with safety margin 0.5 cm
  2. Better to be elliptical for cosmetic closure of the wound.
  3. The raw area is covered by skin graft or by primary closure
  4. The pathologist should check that an adequate safety free margin has been excised, and if not, revisional surgery or radiotherapy should be applied.

#### B - Irradiation

- Tumor is very radio-sensitive
- Best by iridium (less penetration) or deep x-ray therapy
- Use shield protection in irradiation

Indications → debilitated patients

##### Contraindications:

- Ulcer infiltrates bone and cartilage (to avoid irradiation necrosis).
- Ulcer near the eye (to avoid irradiation Cataract).
- Recurrence after irradiation (to avoid irradiation resistance).

### Recently

1. Cryosurgery by liquid nitrogen (especially in eye lids and ears).
2. Topical cytotoxic therapy (5 Fluorouracil)

**Summary:**

- 1- Ulcer < 2 cm → Irradiation or excision with 0.5 cm safety margin & skin graft.
- 2- Ulcer > 2 cm → Excision with 0.5 cm safety margin & skin graft.

**Prognosis**

- If the lesion is completely excised the cure rate is 100%.
- Recurrence of the lesion is due to leaving behind foci of malignant cells and this is more liable to occur if there is infiltration of bone or cartilage.

## 2. Squamous Cell Carcinoma (Epithelioma)

**Definition**

- Malignant tumor from skin squamous epithelium.

**Age & sex**

- Male > 40 yrs

**Predisposing factors**

- ▶ **Etiology:** as skin cancer, marjolin's ulcer, carcinogens
- ▶ **Path.:** ulcer, cell nests
- ▶ **Spread:** direct > lymphatic > blood
- ▶ **C/P:** ♂ > 40 years with nodule, ulcer, LN
- ▶ **Comp.:** as BCC + distant metastasis
- ▶ **Invest.:** biopsy, X-ray, CT & sentinel LN study
- ▶ **TTT:** surgical, irradiation, ttt of enlarged LN

***As basal cell carcinoma + marjolin ulcer & carcinogenic agents***

- Exposure to sun rays, Ultra-violet rays (**Most important**) so the disease is more common in Farmers & Sailors.
- Previous Irradiation.
- Albinism & Xeroderma Pigmentosa (AR).
- Longstanding irritation of the skin as in chronic ulcers, old burn scars & sinuses (A carcinoma arising on top of scar is called Marjolin Ulcer & there is usually a delay in its diagnosis.)
- Prolonged exposure of the skin to carcinogenic agents as coal tar derivatives.
- Patients receiving immunosuppressants.

**Pathology****Site**

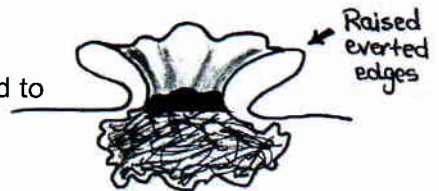
- Any site covered with squamous epithelium especially upper part of the face, lower lip and the dorsum of hands.
- On top of squamous metaplasia (may be)

**Macroscopic**▪ **Types**

- Starts as a small nodule then enlarged to take one of the following forms  
→ Ulcer (commonest)

### ▪ Ulcer (CCC)

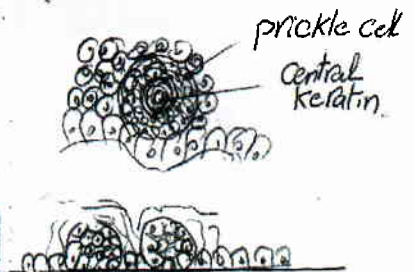
1. **Shape** → Rounded, oval or irregular.
2. **Number** → usually single but may be multiple
3. **Base** → Indurated and it becomes rapidly fixed to underlying tissues..
4. **Floor** → necrotic
5. **Edge** → everted
6. **Margin** → early soft & late indurated.
7. **L.N.** → Early enlarged & soft (due to infection)  
2ry infection may occur and there may be blood stained discharge.  
Late hard (due to infiltration)



Epithelioma (Squamous cell carcinoma)

### Microscopic

- Differentiated SCC → with **cell nests** (Prickle cells + keratin in the center)
- Undifferentiated SCC → with masses of malignant cells (Anaplastic cells with basophilic cytoplasm which provide no cytological evidence of their origin)



Cell nests if present carry better prognosis than sheets

### Spread

- Direct > lymphatic > blood
  - In a patient with Marjolin's ulcer the scarring makes lymphatic spread late.

### Clinical Picture

- Type of patient:
  - ♂ > 40 years
  - Fair colored people
  - Farmers & sailors
- Nodule
  - Painless nodule → Ulcer resistant for ttt.
- Ulcer
  - Rapidly growing
  - Characters : As before (in pathology).
- Lymph Nodes
  - Enlarged in
    - 2ry infection → elastic & tender
    - Metastasis → Hard & fixed



### Differential Diagnosis

1. Rodent ulcer
2. Malignant melanoma.
3. Septic granuloma.
4. Chancre
5. Keratoacanthoma

### Complications

1. Infiltration of the surrounding
2. Secondary infection
3. Hemorrhage
4. Distant metastasis & cachexia.

## Investigations

1. Biopsy → excisional or incisional
2. X-ray → To detect bony involvement
3. Sentinel L.N study: affected L.Ns
4. CT scan.

## Treatment

- Two modalities of treatment are available (Surgical and radiological).

## A -Surgical

### ■ Indications of surgery:

- a. Small lesions.
  - b. Infiltration of cartilage or bone.
  - c. Radioresistant lesions.
  - d. Marjolin's ulcer.
  - e. Block dissection of metastatic LNs.
1. Excision with safety margin is at least 2 cm except in the face where it is 1 cm.
  2. Better to be elliptical for cosmetic closure of the wound.
  3. The raw area is covered by Skin graft or by Primary closure

## B - Irradiation

- The main indication of radiotherapy is for tumors of the head and neck particularly for poorly differentiated tumors.

## If LNs enlarged by metastasis (SCC only)

1. If LNs are close to tumor → excised with 1ry lesion in 1 block.
2. If LNs are away from tumor → block dissection later on (after 2 wks), to avoid postoperative lymphedema and picking up of micrometastasis.
3. No prophylactic block dissection in skin malignancy.

## Prognosis

- 90% 5 year cure rate.

## More details

### ➡ TTT of malignant melanoma (operable cases – 1ry tumor):

#### ▶ Other authors believe that:

- < 1 mm → 1 cm safety margin.
- 1 – 2 mm → 2 cm safety margin.
- > 2 mm → 3 cm safety margin.

### ➡ Surgical TTT of SCC:

- Other authors believe that → 1 cm safety margin is taken for all lesions



|                        | BCC                                                                                                                                                                                                                                                                                                                                                                      | SCC                                                                                                                                                                                                                                                                                                                                               |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Definition</b>      | Locally malignant                                                                                                                                                                                                                                                                                                                                                        | malignant                                                                                                                                                                                                                                                                                                                                         |
| <b>Incidence</b>       | Male old age                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                   |
| <b>PDF</b>             | <ul style="list-style-type: none"> <li>Exposure to sun rays, <b>Ultra-violet rays (Most important)</b> so the disease is more common in Farmers &amp; Sailors.</li> <li>Albinism &amp; Xeroderma Pigmentosa (AR). Predispose to multiple basal cell carcinoma all over the body.</li> <li>Ionizing radiation.</li> <li>Patients receiving immunosuppressants.</li> </ul> | <ul style="list-style-type: none"> <li>Longstanding irritation of the skin as in chronic ulcers, old burn scars &amp; sinuses (a carcinoma arising on top of scar is called Marjolin's Ulcer &amp; there is usually a delay in its diagnosis.)</li> <li>Prolonged exposure of the skin to carcinogenic agents as coal tar derivatives.</li> </ul> |
| <b>Pathology:</b>      | Any site                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                   |
| <b>1. Site</b>         |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                   |
| <b>2. Macro-</b>       | 1-2-3-4-5-6-7                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                   |
| <b>3. Micro-</b>       | Cell mass (pallisade) with fibrous stroma                                                                                                                                                                                                                                                                                                                                | Nodular or ulcer differentiated (cell nest) & undifferentiated                                                                                                                                                                                                                                                                                    |
| <b>Spread</b>          | Only direct (locally malignant)                                                                                                                                                                                                                                                                                                                                          | Direct, blood & lymph                                                                                                                                                                                                                                                                                                                             |
| <b>C/P</b>             | ♂ > 40 years, fair colored people, farmers & sailors                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                   |
| <b>Type of patient</b> | Painless nodule Ulcer resistant for ttt.                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                   |
| <b>Nodule</b>          | slowly growing                                                                                                                                                                                                                                                                                                                                                           | Rapidly growing                                                                                                                                                                                                                                                                                                                                   |
| <b>Ulcer</b>           | No LN except if infected or malignant transformation                                                                                                                                                                                                                                                                                                                     | Enlarged in infection and metastasis                                                                                                                                                                                                                                                                                                              |
| <b>L-node</b>          |                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                   |
| <b>Complications</b>   | <ul style="list-style-type: none"> <li>Hemorrhage, infection, infiltration</li> <li>Malignant transformation</li> </ul>                                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Metastasis</li> </ul>                                                                                                                                                                                                                                                                                      |
| <b>DD</b>              | <ul style="list-style-type: none"> <li>Malignant melanoma</li> <li>Septic granuloma</li> <li>Chancre</li> <li>Cock's peculiar tumor</li> <li>SCC</li> </ul>                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Keratoacanthoma</li> <li>BCC</li> </ul>                                                                                                                                                                                                                                                                    |

▪ **Investigations:** biopsy – X-ray – CT & sentinel LN study.

▪ The best way to deal with enlarged lymph node in BCC is follow up, while in SCC is block dissection.

### 3. Malignant Melanoma

- It is either **denovo** or on top of benign melanoma.

#### Predisposing factors

As all skin malignancy + racial factor & benign lesion

- 1- Prolonged exposure to sunlight (UV rays)
- 2- On top of benign melanoma, exposed to frequent irritation (chemical – mechanical).
- 3- Albinism, retinitis pigmentosa.
- 4- Racial factors (rare in negros).

- ▶ **Etiology:** as malignancy, racial, benign lesions
- ▶ **Types:** superficial spreading (commonest)
- ▶ **Class.:** Clarck's "depth"
- ▶ **C/P:** as cancer (nodule or ulcer)
- ▶ **Invest.:** as cancer + biopsy
- ▶ **TTT:** - operable: excision  
- Inoperable: chemotherapy

#### Incidence

- Disease of adult and old age.
- Male : female (1.2: 1).
- The incidence is increasing in western countries which may be due to defective ozone layer.

#### Pathology and clinical types (according to WHO classification)

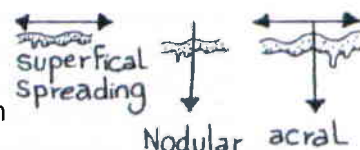
##### 1- Superficial spreading melanoma (the most common) 64%

- **Age:** usually middle age.
- **Site of lesion:** any part of the body  
in male → (mainly in the trunk)  
in female → back and legs
- **Character of lesion:** raised above surface and has irregular edge.
- **Prognosis:** good as malignant melanocytes spread along the epidermis (radial growth).



##### 2- Nodular melanoma 12-25%

- **Age:** usually in younger age groups.
- **Site:** common in trunk, head and neck
- **Character:** raised above surface, grey or black in color with smooth surface and liable to ulceration.
- **Prognosis:** bad as malignant melanocytes invade the dermis (vertical growth) without radial growth phase



##### 3- Acral lentiginous melanoma 2-8 %

- **Age:** more than 60 years of age (dark skinned patient)
- **Site:** palm, sole, under nail
- **Character:** may simulate any other type.
- **Prognosis:** very poor (starts by radial then later on vertical growth)

##### 4- Amelanotic melanoma

- **Malignant melanoma** which arise in the eyes, meninges or at mucocutaneous junctions as the anal canal.
- **Diagnosed by:** DOPA reaction test – biopsy.
- **Prognosis:** poor.



## 6- Lentigo maligna (Hutchinson's melanotic freckles) 1-15%

- **Age:** elderly person
- **Site:** usually in face
- **Character:** it begins as a flat brown macule which grows very slowly. Some areas may regress.
- **Prognosis:** it is the least malignant type.

## 7- Malignant transformation on top of benign melanoma:

- **Asymmetry:**
  - ↑ size & thickness.
  - One half unlike the other half.
- **Border**
  - Irregular – poorly defined.
- **Color**
  - ↑ pigmentation
  - Varies from tan, brown, black (sometimes white red or blue)
- **Consistency** → hard + LNs
- **Character** → itching – tingling – ulcer – bleed.
- **Diameter**
  - Usually > 6mm
  - Satellite nodules develop around it

## Spread

- **Direct** → radial or vertical growth.
- **Lymphatic** → deposits & retrograde permeation with satellite nodules around the tumour.
- **Blood** → high affinity to live (metastasis specially from choroids).

## Classification (Clark's histological stages)

### I- Clark's classification (according to depth in skin):

- a. Epidermal.
- b. Dermo-epidermal junction.
- c. Superficial papillary dermis.
- d. Deep papillary dermis.
- e. Subcutaneous tissue.

### II- Breslow classification ✓ (more used because it is better in predicting prognosis)

1. Skin infiltration < 0.75 mm.
2. Skin infiltration 0.75 – 1.5 mm.
3. Skin infiltration 1.75 - 4 mm.
4. Skin infiltration > 4 mm.

## Diagnosis

### 1. C/P of malignant melanoma

(The only sure method of diagnosis is histological examination, however malignant melanoma can be suspected clinically with A, B, Cs of melanoma)

#### ► Symptoms

- 1- **Denovo lesion.**
- 2- **Malignant changes** in benign naevus.
  - Rapidly growing, itching, pain, change of color, hemorrhage or ulcer.
- 3- Occult presentation.

- 4- **Transit metastasis** → Enlarged micro-metastasis after removing of the 1<sup>ry</sup> tumor.

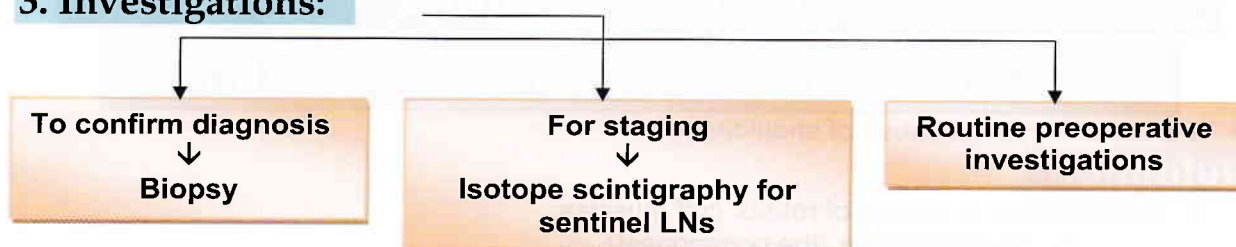
## ► Signs

1. **Nodule or ulcer** of variable colors (from amelanotic to black)
2. **Satellite lesions** may be seen.
3. **Regional L.N. or liver metastasis**

## 2. DD

- 1- Granuloma.
- 2- Pigmented basal cell carcinoma.
- 3- Hemangioma
- 4- Compound or junctional naevus

## 3. Investigations:



## → : How to take biopsy?

- 1- The line of incision should confirm to the possible subsequent excision.
- 2- Safety margin should be 3 mm.
- 3- Biopsy should include the whole skin and subcutaneous tissues to allow pathologist to determine Clark's level and Breslow thickness.
- 4- Paraffin section is better than frozen section.

## Treatment

### A- Operable:

Surgical excision of the 1<sup>ry</sup> lesion with adequate safety margin of skin and SC tissues but not including deep fascia

#### 1. For 1<sup>ry</sup> tumor:

- < 1mm → 1cm safety margin.
- 1 – 4 mm → 2 cm safety margin.
- > 4mm → 3 cm safety margin.

#### 2. For draining LNs:

- Prophylactic dissection of LNs is no more performed.
- Radical dissection is performed if they are large & firm, but if not frankly malignant by clinical examination → FNABC is performed.

### B- Inoperable tumor (stage 4)

- Metastasis is treated by interferons, chemotherapy and interleukin-2.

## Prognosis

- According to type & rate of growth.
- Prognosis of malignant melanoma depends on depth of the tumor as depth ↑ prognosis become more worse.



# Muscles, Tendons & Fascia

## A- Chronic tendonitis:

- 1- Rotator cuff tendonitis.
- 2- Tennis elbow.
- 3- Stenosing tenovaginitis.
  - a- Trigger finger.
  - b- De Quervain's tenosynovitis.

## B- Chronic bursitis:

- 1- Anatomical bursae.
- 2- Adventitious bursae.

## C- Soft tissue sarcomas.

## D- Miscellaneous.:

- 1- Carpal tunnel S..(see neurosurgery).
- 2- Dupuytren's contracture.
- 3- Volkmann's ischemic contracture...(see orthopedics)

## A.Chronic Tendonitis

### 1- Rotator Cuff (Supraspinatus) Tendonitis

➔ It is the commonest cause of shoulder pain.

#### Definition

- Inflammation of tendon of rotator cuff muscles:
  1. Supraspinatus (the commonest).
  2. Infraspinatus.
  3. Subscapularis.
  4. Teres minor.
- It extends to involve the subacromial bursa.

#### Etiology

- Repeated trauma from sports.

#### Clinical picture

- Painful active abduction when shoulder moves between 60° & 120° (**Painful arc syndrome**).

#### Treatment

1. NSAIDs.
2. Shoulder immobilization for few days only.
3. Gradual active exercise to restore full range of shoulder movement.
4. Local injection of corticosteroid lidocaine → in resistant cases.

### 2- Tennis Elbow

#### Definition

- Pain in the elbow at rest & while moving hand (wrist joint).

#### Etiology

1. Direct trauma to common extensor origin at lateral epicondyle.
2. Repeated athletic activity

#### Treatment

1. Rest.
2. Local injection of corticosteroid lidocaine → in resistant cases.

### 3- Stenosing Tenovaginitis

#### Definition

- It is a case caused by a fibrous stricture in a tendon sheath, including:
  - a. Trigger finger.
  - b. De Quervain's tenosynovitis.

#### a. Trigger finger

#### Definition

- Thickening of fibrous flexor sheath at MCP joint producing pain on tendon movement.

#### Incidence

- Middle aged women & young children.

#### Pathogenesis

- Flexion of finger → part of the tendon proximal to constriction get swollen → can't extend the finger → lock the finger in flexion.

#### Clinical picture

1. Local tenderness on MCP joint.
2. Passive assistance needed to extend the affected finger.
3. Swelling at the level of the head of metacarpal bone.

#### Treatment

- Division of constricting fibrous flexor sheath.

#### b. De Quervain's Tenosynovitis

#### Definition

- Inflammation of tendon sheath of:
  1. Abductor pollicis longus.
  2. Extensor pollicis brevis.while crossing the wrist.

#### Clinical picture

- Active & passive movements of the thumb exaggerate the pain & limit movement.

#### Treatment

- Division of the constricting tendon sheath.

## B. Chronic Bursitis

### Definition of bursae

- It is a sac lined with synovial membrane containing fluid.

### Etiology

- 1- Traumatic: affect anatomical and adventitious
- 2- Infective:
  - Suppurative
  - Tuberculosis
  - Syphilis
- 3- Tumors: very rare

### 1- Anatomical bursae

- 1- Around the knee:
  - Pre-patellar (housemaid)
  - Infra-patellar (clergyman's knee)
  - Semi-membranous
- 2- Olecranon (students)
- 3- Subhyoid
- 4- Radial bursa
- 5- Ulnar bursa

### *I. Semimembranous Bursitis*

### Clinical picture

#### 1) History (symptoms)

- Adult age, presenting with painless or painful swelling in the popliteal fossa

#### 2) On examination (signs)

- Cystic swelling on the upper medial part of the popliteal fossa, flaccid with flexion and tense with extension. (DD: Baker cyst → lies in the midline)

### D.D.

- 1- Baker's cyst
- 2- Popliteal aneurysm
- 3- Other swellings in the popliteal fossa

### Investigations

- Plain X-ray for the knee joint may be done to diagnosis associated lesion

### Treatment

- Excision for primary type
- If secondary to knee effusion, treat the cause.

## II. Ulnar Bursitis

### Anatomy

- Larger than radial bursa.
- Distally connected with synovial sheath of little finger.
- Proximally → run between the flexor retinaculum and pronator quadratus → extend to the forearm (**called space of Parona**).
- Envelop the flexor tendons of the medial 4 fingers.

### Etiology

#### Organism

- Staph (80%), Strept, E. coli, G -ve bacilli.

### Predisposing Factors & Route

- 1- Bad hygiene.
- 2- Bad general condition.
- 3- More in manual workers & housewives.

### Clinical Picture

#### Symptoms

- **General** → FAHM.

- **Local:**

Pain → **dull aching** then become **throbbing** when pus is formed.  
→ Decreased by elevation of the hand.

Swelling → according to site e.g. pulp space → distal phalanx, acute paronychia  
→ nail fold, edema at the dorsum of the hand is common, irrespective of the site of infection.

Disturbance of function → limited movement.

Swelling of little finger, palm, distal part of forearm.

#### Signs

- **General:**

- See Before.

- **Local:**

- See before.
- Slight semiflexion of the little finger (hook sign).
- Limitation of movements of the medial 4 fingers.
- Edema of the dorsum.
- **Kanavel's sign:** tenderness over an infected ulnar bursa between transverse palmar creases & hypothenar muscles.

### Complications

1. Sloughing of the tendon due to interfering with nutrition of the tendon.
2. Adhesions inside the synovial sheath → limitation of movement.
3. Osteomyelitis.
4. Arthritis.



## Treatment

### Before Suppuration

- **General:** antibiotics, analgesics, antipyretic. (AAA)
- **Local:**
  1. Hot fomentation.
  2. **Arm position** → to diminish pain & edema.
    - Minor infection → arm to neck sling.
    - Major infection → elevated above level of body.
  3. **Hand position:**
    - If resolution is expected → **position of rest:**
      - ⇒ Description of position: the patient grasps a ball of cotton with max Flexion of little finger, least flexion of index with the thumb in opposition.
    - If stiffness is expected → **position of function**
      - ⇒ The fingers are approximated to the thumb as if holding something.
      - ⇒ Especially in tenosynovitis for fear of fibrosis of tendon & shortening → clawing of hand.



**Position of rest**

### After suppuration → Incision & drainage

1. **Should be done once pus is formed.**
2. **Under general anesthesia**, ring anesthesia for minor cases (better to be avoided).
3. **Bloodless field** by:
  - Elevated the limb for 2 minutes.
  - Sphygmomanometer calf is inflated for 40 mmHg above systole.
4. **Incision:**
  - Along radial border of hypothenar eminence  
In severe cases → counter incision at the lower part of forearm
5. **All pus is removed** & granulation tissues are currated.
6. **No drain is allowed** because it causes pressure to delicate structures **but a piece of tulle-grass** might be allowed.
7. **Dry dressing is employed;** changed after the 1<sup>st</sup> day, then every 2 hours.

## III. Radial Bursitis

### Anatomy

- Small in size.
- Distally connected with synovial sheath of the thumb.
- Proximally → run between the flexor retinaculum and pronator quadratus → extend to the forearm (**called space of Parona**).
- Envelops the tendon of flexor pollicis longus.

### Etiology

### Organism

- See before.

## Predisposing Factors & Route

- See before

## Clinical Picture

### Symptoms

- See before + swelling of thumb, thenar eminence & distal part of forearm.

### Signs

- **General:** see before.
- **Local:**
  - See before + thumb is semiflexed.

## Complications

- Sloughing of the tendon due to interfering with nutrition of the tendon.
- Adhesions inside the synovial sheath → limitation of movement.
- Osteomyelitis
- Arthritis.

## Treatment

- See before +

### Incision

- On the ulnar side of thenar eminence stopping proximally 1.5 inches distal to the distal crease of the wrist to avoid injury of the motor branch of median nerve
- In severe cases → counter incision

## 2- Adventitious bursae

1. Over the head of shoulder (porters)
2. Over external malleoli (trailors)
3. Over the big toe (bunion)
4. Over the amputation stump.

## C. Soft Tissue Sarcoma

### Definition

- Malignant connective tissue tumors arising in the extra skeletal connective tissue.

### Incidence

- Commonest in the 5<sup>th</sup> & 6<sup>th</sup> decade of life, yet they occur in all age groups including children.
- 1 % of all malignant tumors.

### Etiology

- ▶ **Exact etiology is poorly understood but those are common association:**
  1. Following radiation for other malignancies: e.g. Hodgkin's lymphoma.
  2. Lymphangiosarcoma on top of the chronic post mastectomy arm oedema.
  3. Neurofibrosarcoma may develop in patients with Von Recklinghausen's disease.

### Types

1. Malignant fibrous histiocytoma.
2. Liposarcoma.
3. Rhabdomyosarcoma.
4. Synovial sarcoma.
5. Malignant nerve sheath tumor.
6. Leiomyosarcoma.
7. Fibrosarcoma.
8. Angiosarcoma.

### Pathology

#### SITE:

- In extremities and pelvic girdle. (Commonest)
- Also in trunk and retroperitoneal.

#### CELL OF ORIGIN:

- Primitive multipotential mesenchymal connective tissue cells, which differentiate during the process of neoplastic transformation.

#### MACROSCOPIC:

- **Capsule:** Well defined false capsule and contents can be easily enucleated; however it is an integral part of the tumor infiltrated with malignant cells which spread well beyond it.
- **Cut section:** fleshy with areas of necrosis and hemorrhage.

### Grades

#### ▶ Depends on :

a) **Histological grading has more influence on prognosis than the type of the tumor**, including:

1. Extent of mitosis.
2. Extent of necrosis.
3. Cellular anaplasia.
4. Pleomorphism.

b) **DNA ploidy:** determines the tumor aggressiveness.

## Spread

- Local:** first within the musculo-fascial compartment in which it arises.
- Direct:** Fascial septa resist spread temporarily, after which extra compartmental spread occurs.
- Blood:** spread from high grade tumors goes mainly to the lungs.
- Lymphatic:** spread is unusual.

## Clinical Picture

- Painless Swelling enlarging over several months (delayed presentation so the tumor is large since first presentation).
- **Consistency:** soft or firm according to amount of deposited collagen.

## D.D

- Benign soft tissue tumors: e.g. lipoma.
- Deep seated hematomas.
- Malignant lymph nodes.
- Bone tumors.
- Tumor like conditions of the soft tissues:
  - Fibromatosis: e.g. desmoid tumor (Paget's recurrent desmoid tumor).
  - Nodular and proliferative fasciitis.
  - Proliferative myositis and myositis ossificans.

## Investigations

### A. For diagnosis

- ▶ **Biopsy:** FNABC or Open biopsy if FNABC is not enough.

### B. For staging

- ▶ **Radiology:**
  - CT scan or MRI: for direct spread.
  - CXR and CT scan : to detect pulmonary metastases.

## Treatment

|                      | Operable                                                        | Inoperable                                                                                                           |
|----------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|                      |                                                                 | (pulmonary metastases , huge retroperitoneal masses, sarcomas that are adherent to important irremovable structures. |
| 1 <sup>st</sup> line | Enucleation                                                     | Combination chemotherapy is the main line of palliation (though not so effective"                                    |
| 2 <sup>nd</sup> line | Amputation is indicated if resection will lead to useless limb. | Palliative surgical excision may be added.                                                                           |



## D. Miscellaneous

### 1- Carpal Tunnel Syndrome

- See neurosurgery.

### 2- Dupuytren's contracture (Palmar fascitis)

#### Pathology

- Progressive thickening & contraction of palmar aponeurosis.

#### Incidence

- M : F = 10 : 1.
- Bilateral in 1/2 cases

#### Etiology

- Idiopathic.
- High incidence in: cirrhotics, alcoholics, epileptics under phenytoin treatment & diabetics.
- Familial.

#### Clinical Picture

- Starts as a nodule at the base of the ring or little fingers.
- Skin adheres to fascia & contracts as well.
- Other fingers progressively become involved.
- Flexion deformity:
  - Involves metacarpophalangeal & proximal interphalangeal joints (**distal interphalangeal joints are free**).
- Palpation of the palm:
  - Reveals firm, irregular shaped nodule, 1 – 2 cm proximal to the base of the ring finger.



#### Treatment

##### a) Early:

- Physiotherapy.

##### b) Late:

- Surgery:
  - Subcutaneous fasciotomy (mild cases).
  - Aponeurosis excision (severe cases).
  - Additional surgeries in severe cases:
    - Joint capsulotomy + skin grafting after excision of deformed skin.

### 3- Volkmann's ischemic contracture

- See orthopedic surgery.

# Hands & Feet

## A- Congenital Anomalies

### B- Injuries:

1. Hand zones and tendon lacerations of the hand.
2. Traumatic amputations of the hand.
3. Mallet fingers

## B- Swellings:

- 1- Simple ganglion.
- 2- Compound Palmar ganglion.
- 3- Giant cell tumor of tendon sheath.
- 4- Glomus tumor. •

## How to examine hand??

Examine each system in turn

### 1st : The musculo-skeletal system (bone, joints, ms, tendons)

#### Inspection

- look for :
  - Any abnormality in shape , size, contour of the hand
  - Any discoloration, scars, sinuses
  - Muscle wasting (thenar & hypothenar)
  - Wrist joint

#### Palpation

- Feel bony areas, site of tenderness, any swellings

#### Movement

- Check the range of movement of all joints
  - a) **Carpometacarpal joint of the thumb** (Flexion, extension, abduction, adduction, opposition)
  - b) **Metacarpophalangeal joints of the fingers** (Flexion, extension, abduction, adduction)
  - c) **Interphalangeal joints** (Flexion & extension)
- Inability to move the joint may be caused by joint disease, skin & fascial thickening, divided tendons, and paralyzed muscle

### 2nd: the circulation

#### Inspection

- Pallor (anemia or ischemia)
- Ischemic atrophy of the pulp of the finger
- Ischemic ulcers, small abscesses & gangrene

#### Palpation

- Temperature of the skin
- Both pulses (radial & ulnar at the rest)

#### Capillary return test:

Observe for rate of filling of vessel below the nail after emptying it (N=1-2 sec)

#### Allen test

1. Ask the patient to make a fist & then compress both radial & ulnar arteries at the wrist of the hand
2. After 10 sec ask patient to open the hand → palm will be white
3. Release the compression on radial artery & watch blood follow to the hand
4. Repeat the procedure but release the compression on ulnar artery

### Auscultation

- For any A-V fistula or vascular tumor
- Measure the blood pressure in both arms

## A. Congenital Anomalies

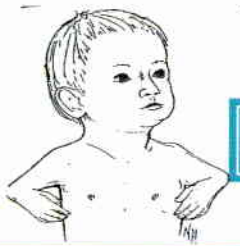
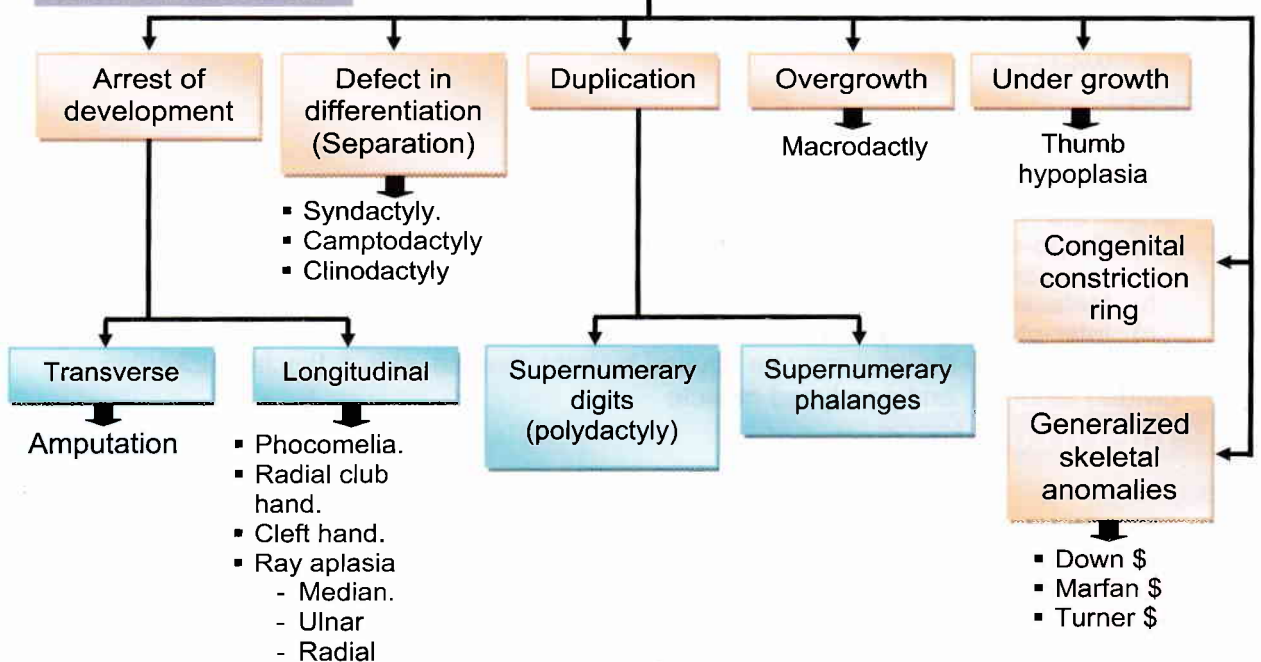
### Incidence

- 1.14 / 1000 live birth
- 5% have other syndromes.
- Hand anomalies are the 1<sup>st</sup> common congenital deformity.

### Etiology

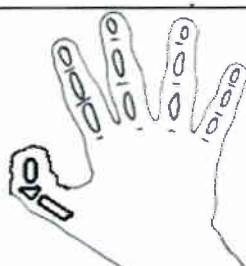
- Genetic (present since time of conception)
- Non Genetic
- Environmental
- Sporadic
- Combination (environmental + Genetic)

### Classification



Radial club hand

Clin  
(radial or ulnar)



Campto  
flexed



# 1- Syndactyly

## Definition

- Webbing or fusion of 2 or more fingers or toes

## Etiology

- As polydactyly (syndactyly results from failure of apoptosis that normally occurs between digits)

## Diagnosis

- 1- It does not interfere with the function of the feet, toes or hand but it may impair function of fingers.
- 2- Most commonly affecting the 3<sup>rd</sup> web space, followed by the 4<sup>th</sup> then the 2<sup>nd</sup> and rarely the 1<sup>st</sup> web space.
- 3- 50% bilateral.

### 4- By external observation:

- Degrees:
  - Simple: digits connected only by soft tissue
    - May be full "extending to the tip of the digits or partial "not extending to the tip of the digits"
  - Complex: the condition is complicated with shared bones, nerves, vessels and or nails.
    - It may be a polysyndactyly (see before)
    - Examine for associated anomalies.



### 5- By investigations:

- X-ray.
- Fetal sonogram.

## Treatment

### ▪ Goals of treatment

- To produce a functional limb
- To improve cosmesis

### ▪ Conservative

### ▪ Physiotherapy

### ▪ Prosthetic

### ▪ Surgical

#### 1- Timing of surgery (variable)

- o *From neonatal period to 4-5 years*
- o *Staged operation should be designed to be completed by school age*
  - If growth is increasing the deficiency: at 1 year of age
  - If the developmental pattern necessitates: at 2 years of age
  - If patient cooperation is necessary: at 4-5 years of age

#### 2-

- a- In case of webbed toes, surgical correction is a purely cosmetic operation with no medical benefits.
- b- Release of fingers, zigzag incision.
- c- Surgical correction separation almost always with the addition of a skin graft from the groin.

## Prognosis

- As polydactyly.



## 2- Polydactyly

### Definition

- Presence of more than the normal number of fingers or toes.

### Etiology

- Usually inherited as an autosomal dominant gene.
- Female = Male (because it is autosomal and not sex-linked)
- It may be isolated or a part of syndrome.

- ▶ **Etiology:** autosomal dominant, ♂=♀
- ▶ **C/P:** rudimentary or developed extra digits
- ▶ **Invest.:** X-ray, fetal sonogram
- ▶ **TTT:** mainly surgical

### Diagnosis

- **By external observation:**
  - It varies from an unnoticed rudimentary finger or toe to fully developed extra digits.
  - When extra digits are fused, it is called polydactyly.
- **By investigations**
  - X-ray.
  - Fetal sonogram



### Treatment

- **Goals of treatment**
  - To produce a functional limb
  - To improve cosmesis

**It is not always possible to achieve these goals in a single stage**

- **Conservative**
- **Physiotherapy**
- **Prosthetic**
- **Surgical**

#### 1-Timing of surgery (variable)

- *From neonatal period to 4-5 years*
- *Staged operation should be designed to be completed by school age*
  - If growth is increasing the deficiency: at 1 year of age
  - If the developmental pattern necessitates: at 2 years of age
  - If patient cooperation is necessary: at 4-5 years of age

#### 2-Surgical removal of the extra digits or partial digits

### Prognosis

- Isolated lesions have an excellent prognosis; otherwise the prognosis depends on the syndrome.



## B. Injuries

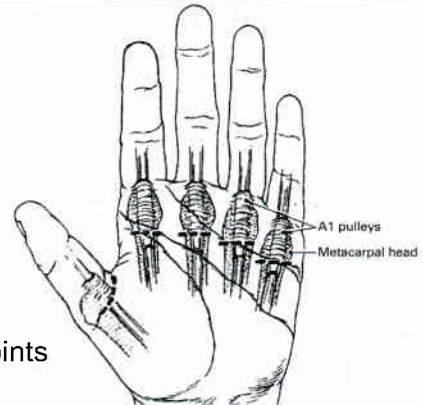
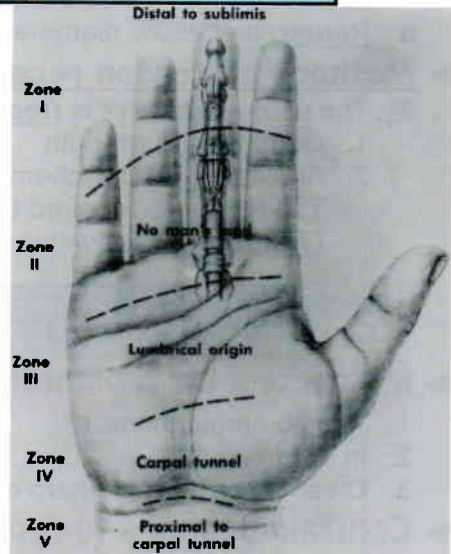
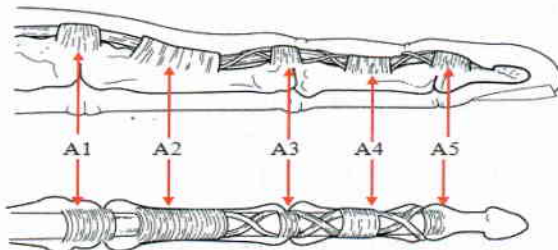
### 1- Hand Zones Injury

#### Anatomy

#### ► **Zones of injury:**

##### 1. FLEXOR TENDONS:

- Flexor tendons are divided into 5 zones
- Zone 1 is distal and Zone 5 is proximal
- The five zones are
  - a) Contains flexor digitorum profundus only distal to the insertion of flexor digitorum superficialis
  - b) From insertion of flexor digitorum superficialis to the proximal edge of the A1 pulley
  - c) From the proximal edge of the A1 pulley to the distal edge of the carpal tunnel
  - d) Within the carpal tunnel
  - e) Proximal to the carpal tunnel



##### 2. EXTENSOR TENDONS:

- Extensor tendons are divided into 8 zones
- Zones 1,3 and 5 lie over the DIP, PIP and MCP joints

#### Introduction

- Flexor and extensor injuries are common
- Flexor tendon injuries are often associated with neurovascular damage
- Extensor tendon injuries often associated with articular damage
- Require careful assessment and management
- Accurate surgical repair required requiring meticulous surgical technique
- If poorly managed can lead to significant functional disability.

#### Treatment

#### ► **General rules:**

1. All flexor tendon injuries require operative exploration, therapy or both.
2. In the emergency department: lacerations with both ends are visualized for repair only can be there.
3. Multiple tendon injuries or those with difficult exposure (i.e.) more proximal should be attempted only in the OR.

4. General treatment to extensor tendon injuries includes: direct repair+splinting for 6-8 weeks.

► **For partial tendon lacerations:**

- ▣ The rule is "No repair" as rates of rupture in repaired tendons may be higher and tensile strength is decreased.
- ▣ **Repair:** any >50% diameter should be ligated.

► **Methods of tendon repair:**

- ☒ The usual method of is (modified Kessler suture):

1. Good tensile strength.
2. Small amount of ischemia induced.

The tendon is repaired by approximation of the epitenon with fine sutures.

**[Timing]:** Repair within 6 days prevents significant contraction.

## 2- Traumatic amputations of the hand

► **Indications for replantation of an amputated digit:**

1. Thumb amputations.
2. In children.
3. Clean amputations (sharp division) at the hand, wrist or distal forearm.

► **Contraindications to replantation:**

**A. Absolute contraindications:**

1. Severe medical problems or associated injuries increasing the risk of surgery.
2. Multilevel injury to the amputated part.
3. Inability to stop smoking for 3 months post replant.
4. Psychiatric illness that precipitated self-amputation.

**B. Relative contraindications to replantation:**

1. Severe crush or avulsion.
2. Amputation between MCP and PIP joints of a single digit.
3. Heavily contaminated wound.

► **Preparation of replantation**

**a) Preparation of the patient:**

1. Debridement of stump with irrigation and dressing with non-adherent gauze.
2. Tetanus prophylaxis.
3. IV antibiotics.
4. IV hydration.

**b) Preparation of the amputated part:**

1. Debridement with irrigation.
2. Wrapping in gauze moistened with lactated Ringer's solution or normal saline.
3. Placement of the wrapped part in sealed container immersed in an ice bath.

### 3. Mallet finger (baseball finger)

#### Detention

- A fixed flexion deformity of DIPJ of a finger

#### Etiology

- Trauma (it is known as baseball finger because commonest cause of injury is a blow on tip of finger)

#### Pathology

- Loss of extensor mechanism of DIPJ due to rupture of extensor tendon or avulsion fracture

#### History

- Inability to extend the tip of a finger (would be great disability to a person with occupation require fine hand movement)

#### On examination

- With the finger extended the distal phalanx remains flex 15 - 20°.



## C. Swellings

### 1- Simple Ganglion

➤ 95% of hand swellings are benign

➤ **Etiology:** mucoid degeneration  
 ➤ **C/P:** painless cystic swelling  
 ➤ **Comp.:** cyst + cancer  
 ➤ **Invest.:** x-ray, excisional biopsy  
 ➤ **TTT:** excision

#### Definition

- Chronic cyst containing mucoid material related to a tendon.

#### Etiology

- Mucoid degeneration of fibrous tissue of tendon sheath.

#### Pathology

- Cyst contains jelly like mucin.

#### Clinical Picture

⇒ **Symptoms**

- Painless swelling at dorsum of the hand or around the ankle.

⇒ **Signs**

- **General:** may be fever if infection.
- **Local:** localized, tense, **cystic** (by Paget test), rounded swelling, moves across the tendon. its mobility is ↓ by pulling on the tendon.



#### Complications

- 1- Infection.
- 2- Hemorrhage.
- 3- Calcification.
- 4- Rupture.
- 5- Malignant changes.

#### Investigations

- X-ray on hand.
- Excisional biopsy.

#### Treatment

- It is not indicated unless the patient insists.
- Aspiration or rupture of cyst by applying direct pressure
- Complete excision under GA until its root in the presence of good light, tourniquet & bloodless field.

### 2- Compound Palmar Ganglion (TB of ulnar bursa)

#### Definition

- TB synovitis of synovial flexor sheath at the fingers → distended with TB granulation tissues.

#### Etiology

- **Causative organism:** Mycobacterium TB.
- **Route of infection:**
  - Direct, inoculation.
  - Lymphatic spread.
  - Blood spread.

## Pathology

- ⇒ **Site:** - Palm. - Distal part of the forearm.
- ⇒ **Macroscopic:**
  - Aggregation of TB follicles lymphangitis and lymphadenitis.
- ⇒ **Microscopic:**
  - TB tubercle formed of central caseation surrounded by epithelial cells, giant langhans cells fibroblasts and fibrocysts.

## Clinical Picture

- ⇒ **Symptoms:**
  - Swelling at palm of the hand and distal part of the forearm.
  - May be on associated TB toxemia, night fever, night sweating, anorexia and loss of weight.
- ⇒ **Signs:**
  - **General:** TB toxemia.
  - **Local:**
    - **Inspection:**
      - Swelling at palm and distal part of forearm, larger in size, may extend to thumb or little finger.
      - Overlying skin may show signs of inflammation.
    - **Palpation:**
      - Swelling with smooth surface, ill-defined edge, cystic in consistency and fluctuant: show "**cross-fluctuation**" due to band of constriction at flexor retinaculum.
      - LNs may show TB lymphadenitis.

## Complications

- |                         |                           |
|-------------------------|---------------------------|
| 1- Secondary infection. | 2- TB spread and toxemia. |
| 3- Hemorrhage.          | 4- Rupture.               |

## Investigations

- ⇒ **Lab:**
  - Tuberculin test. - CBC → leukopenia with relative lymphocytosis.
  - ESR >100
  - Aspiration and culture on Lowenstein Jensen media.
  - PCR.
- ⇒ **Imaging:** CXR.

## Treatment

- ⇒ **Medical treatment:**
  - Sanatorial treatment. - Antituberculous drugs.
  - Immobilization in plaster of paris.
- ⇒ **Surgical:**
  - Aspiration by z-technique.
  - If failed → Complete excision under umbrella of anti-tuberculous drugs.
- **Prognosis:**
  - Depends on a patient's resistance and virulence, and load of bacteria.
  - Good immunity → fibrosis.
  - Low immunity. - Caseation.
  - Coalesce. - Cold abscess.



### 3- Giant Cell Tumor of Tendon Sheath

- Painless mass on volar or dorsal aspects of finger.
- Interfere with tendon movements, compress digital nerve & erode bone.

#### Treatment

- Meticular excision.
- Recurrence is treated by re-excision combined with radiotherapy.

### 4- Glomus Tumor (Angioneuroma)

#### Definition

- The tumor arising from A-V shunt in extremities

#### Pathology

- Vascular, neuron & smooth muscle fibers elements.

#### Clinical picture

- Appear as minute very tender purple spot under the nail
- Paroxysmal pain is induced by pressure or change in temperature

#### Treatment

- By excision

## Face, Lips & Palate

### A- Congenital anomalies

- Cleft lip and palate

### B- Trauma

- Maxillofacial injury

### C- Inflammation

- Boil, carbuncle..... (see general)
- Cavernous sinus thrombosis.....(see neurosurgery)

### D- Neoplasm

- Lip cancer

## i. Congenital anomalies

## Cleft Lip (Hare Lip) & Cleft Palate

### Congenital anomalies of the face

1. Cleft lip.
2. Cleft palate.
3. Preauricular sinus: This is due to imperfect fusion of the auricular tubercles.
4. Dermoid cysts: Sequestration dermoid cysts occur at the lines of embryonic fusion. The most frequent is the external angular dermoid.
5. Pierre Robin syndrome: Consists of cleft palate associated with receding mandible and posterior displacement of the tongue obstructing the oropharyngeal airway.
6. Mandibular prognathism.

### Embryological considerations

- The development of the oral region occur (4<sup>th</sup>-8<sup>th</sup>) Intra-uterine.
- The oral membrane is surrounded by 5 process
  - ✓ Fronto-nasal part
  - ✓ Maxillary part
  - ✓ Mandibular part

### Development of lips & palate

1. Upper lip → by fusion of **Fronto-nasal + Maxillary**
2. Lower lip → fusion of **2 Mandibular process**.
3. Ant part of (alveolar margin + palate) → **Fronto-nasal process**.
4. Post part of (alveolar margin + palate) → **Maxillary process**

### Incidence

- Cleft lip and cleft palate are the second most common congenital deformity (hand deformities are the first).
- Females : males = 2 : 1 (1:700 live births).
- 25% of additional anomalies: neurologic, cardiac & club foot.

### Etiology

#### A. Familial risks:

- General population: 0.14%.
- One child affected: 5%.
- One parent & one child: 15%.
- Two children: 20%.

**B. Environmental factors:**

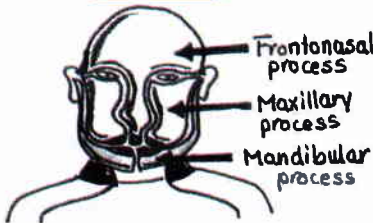
1. Drugs: steroids, diazepam, phenytoin & phenobarbital.
2. Irradiation.
3. Viral infections (e.g rubella)
4. Maternal smoking & alcohol intake.
5. Advanced maternal / paternal age.

**C. Syndromes associated with facial clefts:****I) Treacher Collins syndrome: (AD)**

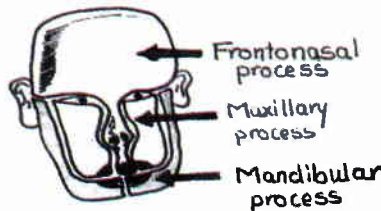
- Absent or deformed zygoma + deformed ears + micrognathia + dropping part of lower eyelid + conductive hearing loss + slanting eyes + cleft lip & palate (6%).

**II) Pierre Robin syndrome:**

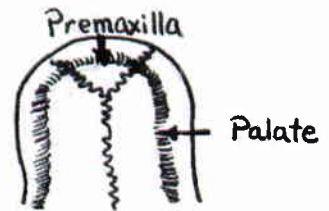
- Isolated cleft palate + retrognathia + posteriorly displaced tongue (glossoptosis).

**III) Others:** e.g. Crouzon's and Apert's syndrome

Embryology of the face



Embryology of the face



Embryology of the palate

**I) Cleft Lip (Hare Lip)****Definition**

- Failure of fusion between the median part of frontonasal process and one or both lateral maxillary processes in developing face.

- ▶ **Types:** lateral, unilateral, complete, complicated
- ▶ **C/P:** - Nose (flatness, disfigurement)  
- Bad (teeth, tone of voice)
- ▶ **TTT:** surgical (Millard's operation)

**Types****I) Lateral or median:**

- **In the upper lip:**
  - Usually lateral.
- **In the lower lip:**
  - It is median.

**II) Unilateral or bilateral:**

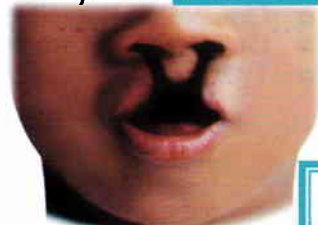
- Unilateral in 85% of cases (**More in the left side**).
- Bilateral in 15% of cases.

**III) Complete or incomplete:**

- **Complete** → The cleft extend upward to the nostril.
- **Incomplete** → The cleft does not extend to the nostril.



Unilateral complete



Bilateral Complete

## IV) Complicated or uncomplicated:

- **Complicated** → With cleft palate, the commonest.
- **Uncomplicated** → Without the cleft palate.

## Diagnosis

### ■ Antenatal diagnosis:

1. By U/S scan after 18 weeks of gestation (if antenatal diagnosis is confirmed, referral to a cleft surgeon for counseling to allay fears) (reassure the patient)

### ■ Clinical picture & Complication:

1. Flaring & flatness of nares on the affected side if complete.
2. Disfigurement.
3. Abnormal teeth growth
4. Nasal tone.
5. Short lip-nose distance.
6. In 35% of cases → Associated congenital anomalies  
e.g. cleft palate, coloboma, encephalocele etc.

## Treatment

### Surgery is the only treatment (Millard's operation)

- **Timing:** 3-6 months
- **Pre-requisites:** The infant should be at least 10 pounds in weight and Hb level at least 10 mg%
- **Goals of lip repair:**
  1. Cosmetic lip repair where all anatomical defects are corrected.
  2. Functional repair of orbicularis oris to preserve function of facial expressions.
  3. Repair of alveolus (anterior palate) in the same setting by:
    - a- Primary gingivo-periosteoplasty.
    - ± b- Primary alveolar bone grafting.

▶ It is called primary when it's done before 2 years of age.

▶ **Aim:** it is needed to help the teeth to erupt.

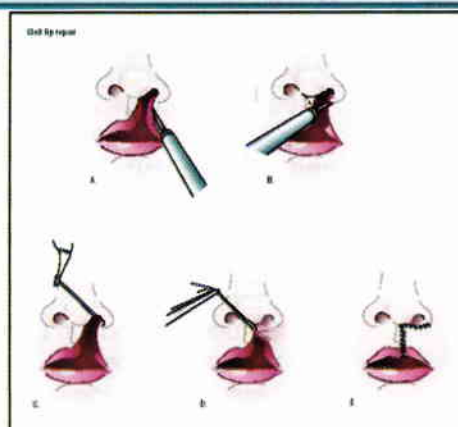
### ➤ **Secondary alveolar grafting is done after 2 years of age (Most successful):**

- Early → 8 – 12 years (transitional dentition).
- Late → after 16 years.

▶ **Advantages:** don't impair the growth of the upper jaw.

- **Principle:** 1- Paring of edges.  
2- Repairing the defect with suturing the three layers of lip (Skin, muscle and mucous membrane).

- Sutures are made in zigzag way not in a straight line (Why?)  
To avoid notching of the lip margin as the scar contract.





## II) Cleft Palate

### Types

1. Cleft uvula.
2. Cleft soft palate.
3. Cleft soft and hard palate (complete)
4. Complete cleft + one side of premaxilla (Bipartite cleft).
5. Complete cleft + both sides of premaxilla (Tripartite cleft).

- ▶ **Types:** cleft uvula ± soft p. ± hard p. ± maxilla
- ▶ **C/P:** - disfigurement
  - poor suckling, sinusitis
  - Bad (teeth, tone of voice, chest)
- ▶ **TTT:** surgical + speech therapy + orthodontic ttt

### Pathology

- Caused by arrest of fusion between the two palatal processes and possibly with the premaxilla.

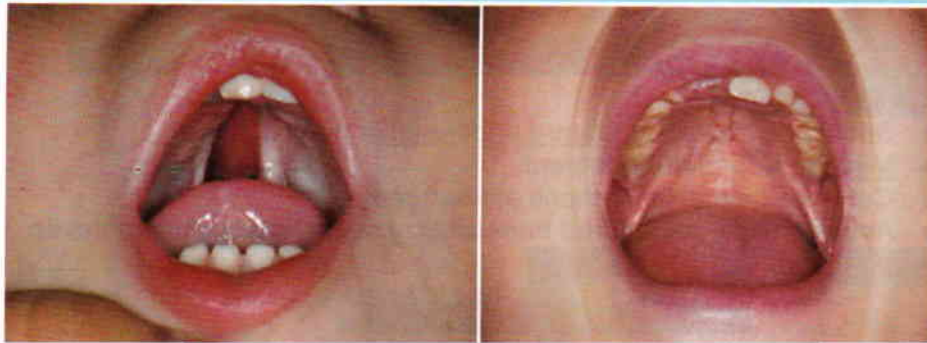
### Diagnosis

- **Antenatal diagnosis:**
  - All types (except isolated cleft palate) can be diagnosed by U/S scan after 18 weeks of gestation (then referral to a cleft surgeon)
- **Clinical picture & Complication:** (Due to communication between the oral & nasal cavities):
  - Impairment of suckling: due to inability to create -ve intra-oral pressure.
  - Impaired speech: due to
    - 1- Inadequate velopharyngeal mechanism: Opposition of velum (the muscles of the soft palate) against the pharyngeal wall to separate the oral from the nasal cavity is impaired. Nasal tone is due to naso-oral communication.
    - 2- Hearing loss.
      - Impairment of dentation if the alveolar margin is reached.
      - Impaired sinus, otitis media due to nasal regurgitation due to impaired aeration of Eustachian tube.
      - Distortion of facial growth.
      - Recurrent chest infection (due to reflux into nose).
      - Usually associated with other congenital anomalies.

### Treatment

- **Time:** 12-18 months
- **Pre-operative management:**
  - 1- Attention to feeding. As there is inefficient breast feeding, a bottle with a large hole is used or spoon feeding in an upright position.
  - 2- Prevention and treatment of chest infection.
- **Objectives of surgery:**
  1. Closure of oro-nasal communication.
  2. Achieving a competent velopharyngeal sphincter.
- **Principles of surgery:**
  1. Paring of edges.
  2. Suturing is done in three layers in the middle line (nasal mucosa, muscle layer, then oral mucosa).
  3. Lateral relaxation incisions are needed.
  4. fracture of the pterygoid hamulus to relax tensor palati





Cleft palate before & after repair

■ **Post-operative treatment:**

1. Speech therapy.
2. Orthodontic treatment.

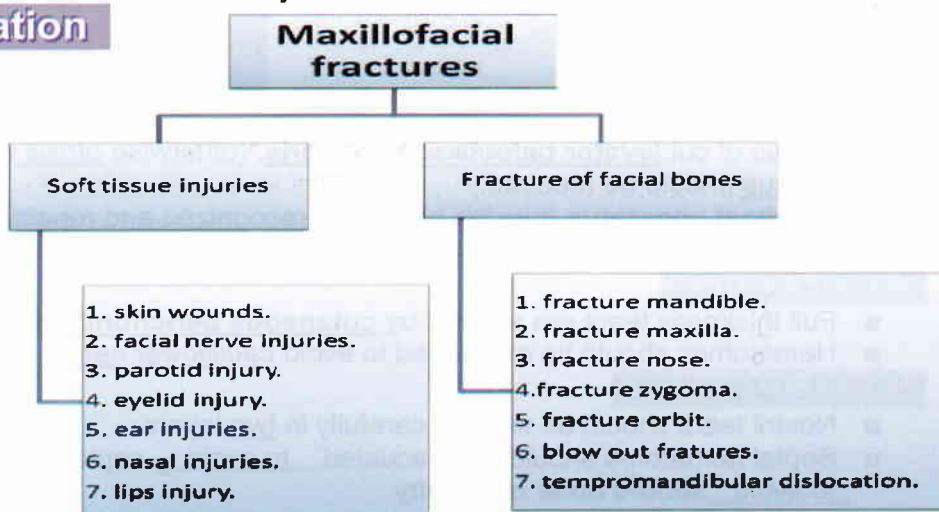
## *ii. Trauma*

# Maxillofacial injuries

## Introduction

- **Maxillofacial fractures are frequent with:**
  1. Road traffic accidents.
  2. Fights.
  3. Contact sports as soccer.
- Isolated facial fractures rarely cause shock.

## Classification

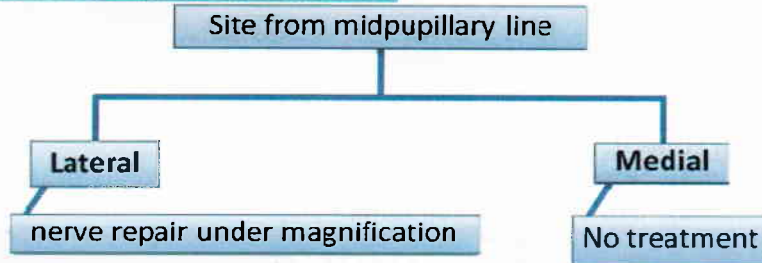


## A. Treatment of Soft tissue injuries

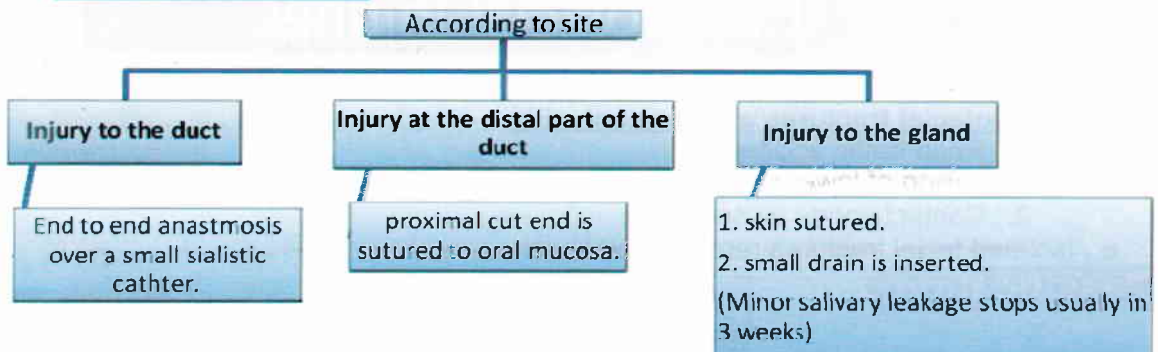
### → SKIN WOUNDS:

- ▣ Should be treated in theatre under sterile conditions.
- ▣ Minimal wound debridement.
- ▣ Cut wounds and lacerations are sutured.
- ▣ Avulsed flaps are sutured back after ensuring vascularity at the tip.

### → FACIAL NERVE INJURIES:



### → PAROTID INJURY:



### → EYELID INJURIES:

- ▣ Repair of cut levator palpebrae superioris. (otherwise ptosis will occur)
- ▣ Tarsus should be repaired.
- ▣ Lacrimal apparatus injuries should be recognized and repaired. (otherwise epiphora and dacrocystitis will result)

### → EAR INJURIES:

- ▣ Full thickness tears are sutured by cutaneous perichondrial sutures.
- ▣ Hematomas should be evacuated to avoid cauliflower ear.

### → NASAL INJURIES:

- ▣ Nostril tears should be sutured carefully in two layers.
- ▣ Septal hematoma should be evacuated to avoid septal hematoma to avoid saddle nose deformity.

### → LIPS INJURIES:

- ▣ Should be sutured in three layers with respect to anatomical landmarks.
- ▣ Intraoral injuries: edges are debrided and loosely approximated.

## B. Fracture of facial bones

### I. Fracture Mandible:

#### Etiology

- Falls, kicks, fist blows, car accidents, or pathological.

#### Sites

- Body is the commonest. (controversial)
- Points of weakness includes:
  - a. Near mental foramen due to marked curvature.
  - b. Deep canine fossa.

#### Types

- Usually compound into the mouth as the muoperiosteum is firmly attached to bone.

#### C/P

1. Pain: especially on attempts to open the mouth.
2. Tenderness over the mandible.
3. Impairment of speech, chewing and swallowing.
4. Malocclusion of the teeth and irregularity of the line of the teeth.
5. Blood stained saliva.
6. Anaesthesia (or hypothesia) of the lower lip. (distribution of inferior alveolar nerve)
7. Swelling of lower face and hematoma in the floor of the mouth (**Coleman's sign**).
8. Abnormal range of mobility.

#### Investigations

- a) **Plain X-ray** is diagnostic.
- b) **Panorex:**
  - Shows the whole mandible. (Poor visualization of condylar fractures and alveolar process fractures).
- c) **CT:** may be needed (good for condylar fractures)

#### Treatment

- 1) First aid:
  - a. 4 tailed bandages for support.
  - b. Analgesics+ Antibiotics+ Mouth hygiene.
- 2) Reduction under anaesthesia + fixation by **intradental wiring** or **arch bars** (for 3-6 weeks) +liquid diet. Usually appropriate for majority of lower jaw fractures.
- 3) **ORIF:** by plates and screws for more complicated fractures.
- 4) **Treatment:** **Gingival buccal sulcus incision** for exposure.

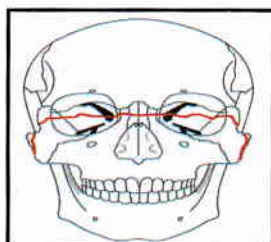
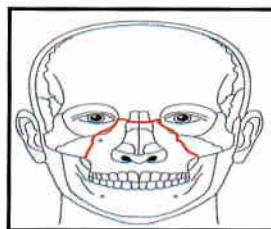
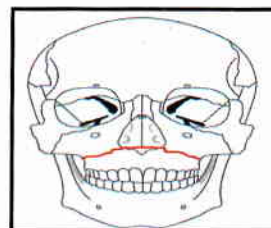
## 2. Fracture Maxilla: [Le Fort fractures]

### Etiology

- Car accidents.

### Types

|                    | SHAPE                    | ACROSS                                                                  | TREATMENT                                                                     |
|--------------------|--------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>Le Fort I</b>   | Transverse               | Above level of the teeth.                                               | Intermaxillary fixation to <u>inferior orbital margins</u> by wires.          |
| <b>Le Fort II</b>  | Pyramidal                | Base of the nose, posterior wall of maxillary antrum & across the orbit | Intermaxillary fixation to <u>zygomatic process of frontal bone</u> by wires. |
| <b>Le Fort III</b> | Craniofacial dysjunction | Separate facial bone from cranial attachment.                           | TTT of Le Fort II + correction of nasal and zygomatic fractures.              |



### C/P

- Pain.
- Swelling.
- Excess salivation.
- Malocclusion.
- Hypoesthesia. (Not in Le Fort I but in **Le Fort II**) → Infraorbital nerve.
- Epistaxis.
- Diplopia.
- Crepitus.

### Investigations

- CT facial bones: Axial cuts and Coronal cuts.

### Treatment

- Coronal incision** for exposure.

### 3. Fracture Nose:

C/P

- ▣ Pain – Swelling – Epistaxis – Crepitus – CSF rhinorrhoea.

#### Treatment

- a. Reduction: digital or instrumental.
- b. **Fixation:**
  - ▣ Intranasal packing for 3 days.
  - ▣ External splint for 7 days.
- c. Neglected old fractures: osteotomy.

### 4. Fracture Zygoma:

C/P

1. Enophthalmos.
2. Ocular dystopia.
3. Numbness and anesthesia.(Infraorbital nerve)
4. Difficult mouth opening.
5. Periorbital echymosis.
6. Subconjunctival hemorrhage.
7. Depressed cheek.
8. Palpable stepping.
9. Epistaxis.

#### Treatment

- ▣ By **Subciliary incisions** for exposure of the wound.

### 5. Fracture orbit:

C/P

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. Periorbital echymosis.      | 3. Numbness and Hypoesthesia. |
| 2. Subconjunctival hemorrhage. | 4. Diplopia.                  |
| 5. Dystopia.                   |                               |

### 6. Blow out fractures:

#### Definition

- ▣ Depressed fracture of orbital floor. Contents of the orbit herniates in the maxillary sinus.

#### Etiology

- ▣ Blow by a fist

### 7. Tempromandibular joint dislocation:

#### Type of patient

- ▣ Very common in middle aged females.

#### Etiology

- a. Direct blows.
- b. Yawning.
- c. Wide opening of the mouth under anaesthesia.



## C/P

- Pain.
- Dysarthria.
- Mouth held open with fixed jaws.
- In unilateral cases: chin is deviated to the opposite side.

## Treatment

a) **Reduction:**

- Under anaesthesia: by downward traction on the molars with the padded thumb, together with upward rotation of the body with the outside fingers.

b) **In recurrent cases:** excision of the meniscus.*iii. Inflammation*

## 1 - Boil

- ➡ See general book.

## 2- Carbuncle

- ➡ See general book.

## 3- Cavernous sinus thrombosis

- ➡ See Neurosurgery.

*iv. Neoplasm***Lip cancer**➤ **Epithelioma is the commonest lip malignancy****Etiology**

- 1- Prolonged exposure to the ultraviolet rays of the sun.
- 2- Continuous irritation and hyperplasia due to cigarette smoking or the use of hot tobacco pipes.

- ▶ **Etiology:** UV rays, smoking
- ▶ **Path.:** SCC, more in lower lip
- ▶ **TTT:** excision or radiotherapy

**Pathology****Histological picture**

- Squamous cell carcinoma which is usually well-differentiated.
- **Gross picture:**
  - ▣ The lower lip is more affected than the upper.
  - ▣ The lesion usually starts as a nodule or erosion which resists treatment.
  - ▣ Later the typical ulcer becomes evident.
    - Raised everted edges
    - Indurated base and margin (may extend beyond the edge).
    - Possibly spread to cervical lymph nodes

**Lymphatic drainage**

- ▣ The central part to lower lip drains to submental nodes.
- ▣ The lateral parts drain to submandibular nodes.
- ▣ Later upper deep cervical lymph nodes are involved.

**Treatment****A. Primary tumor**▶ **Surgery**

- ▣ Excision should include the lesion with a safety margin.
- ▣ For lesions involving up to one third of the lip surgical treatment can be accomplished by " V" shaped excision and primary suture in 3 layers ; mucosa, muscle and skin.
- ▣ For bigger lesions plastic reconstruction will be needed.

▶ **Radiotherapy**

- ▣ Is a good alternative because squamous cell carcinoma is radio-sensitive.

**B. Lymph nodes**

- ▣ If there are lymph node metastases, a suprahyoid or a complete block dissection is performed.

**Prognosis**

- ▣ Epithelioma of the lip has a better prognosis than that of the cheek, tongue or the floor of the mouth.

**Ulcers of the Lip**

|               |                                       |                    |
|---------------|---------------------------------------|--------------------|
| Lip cancer    | T.B. ulcer                            | Aphthous ulcer     |
| Cold sores    | Hereditary hemorrhagic telangiectasia |                    |
| Lip burn      | Canker sores                          | Impetigo           |
| Dermatitis    | Contact dermatitis                    | Candidiasis        |
| Chancre       | Leukoplakia                           | Zinc deficiency    |
| Lichen planus | Behcet's ulcer                        | Erythema multiform |

## Mouth, Cheek & Tongue

### A- Congenital anomalies

- 1- Tongue tie.
- 2- Macroglossia.

### B- Trauma

- ▣ Tongue injuries

### C- Inflammation

- 1- Glossitis.
- 2- Tongue ulcers.

### D- Neoplasm

1. Intra oral tumors.
2. Cancer tongue,
3. Cancer cheek

### D- Miscellaneous

- ▣ Ranula

## *i. Congenital anomalies*

### 1- Tongue tie (Frenotomy)

#### Definition

- ▣ Adherence of the tongue to the floor of the mouth anteriorly by complete frenulum, affecting the function of the tongue.

#### Timing of surgery

- ▣ Should be before speech development

#### Technique

1. Cut the lingual frenulum.
2. Most babies don't need stitches.



### 2- Macroglossia

#### Definition

- ▣ Persistent painless enlargement of the tongue.

#### Etiology

#### A. Congenital:

1. Cavernous hemangioma.
2. Congenital A-V malformation.
3. Lymphangioma.
4. Neurofibromatosis.

#### B. Acquired:

1. Cretinism.
2. Acromegaly.
3. Amyloidosis.

*ii. Trauma***Tongue injuries****Etiology**

- Biting is the commonest cause.

**Clinical picture**▶ **Type of patient:**

1. Epileptic patients can bite their own tongue during attacks.
2. Polytraumatized patient associated with jaw fractures.

▶ **Symptoms:**

- Bleeding → lingual artery (if the patient is unconscious → aspiration of blood).

**Treatment**

1. Pull the tongue (compress the lingual artery against the mandible).
2. Suturing lacerations.
3. Hematoma compressing airway → tracheostomy.

*iii. Inflammation***1- Chronic Superficial glossitis**

- It is a **precancerous** condition.

**Etiology**

- This is due to chronic irritation (**S**moking, **S**harp tooth, **S**epsis, **S**yphilis, **S**pirits and **S**pices). It occurs in middle and old age.

**Site**

- Anterior 2/3 of the tongue.

**Pathology**

- Hypertrophy of the papillae produces red hyperaemic patches.
- Overgrowth of the epithelium makes it thickened, indurated and opaque so that the red patches are replaced by white ones (leukoplakia).
- In the next stage, the epithelium may be shed over a considerable area producing a red glazed tongue.
- Submucous fibrosis occurs causing ulcers, fissures and warty projections.

**Treatment**

- 1- Elimination of the irritating source.
- 2- Mouthwash.
- 3- In resistant cases, excision of the lesion.

## 2- Tongue Ulcers

- Site, Size, Shape, Pain, Edge, Floor, Base, LN, Treatment

### A-Traumatic ulcers

#### 1-Dental ulcer

- **Site**: on the side of the tongue opposite a decayed or broken teeth or an ill fitting denture
- **Size** : small
- **Number**: single
- **Shape**: oval or rounded
- **Pain** : painful
- **Edge**: sloping
- **Floor**: containing granulation tissue
- **Base**: soft
- **LN**: septic enlargement of draining LN
- **Treatment**: Remove affecting tooth, take biopsy of the ulcer edge & antiseptic mouth hygiene

#### 2- Frenal (post- pertussis)

- Occurs in children with whooping cough as they protrude their tongue during cough.
- They are transverse linear ulcer on the undersurface of the tongue in the midline.

### B- Inflammatory

#### a) Acute

#### 1- Aphthous ulcer (Dyspeptic ulcer)

- **Etiology**: unknown
- **Site**: The whole oral cavity especially near the tip of tongue
- **Shape**: rounded
- **Number**: multiple
- **Pain** : painful
- **Margin**: red
- **Base**: soft
- **LN**: Not enlargement
- **Treatment**: antiseptic mouth wash , NaHCO<sub>3</sub> lotion & anesthetic gel

#### 2- Lichen planus

- Autoimmune disease associated with tongue ulcers and hyperkeratotic lesions.



### 3- Herpetic ulcers

- Unilateral eruption of small vesicles on the tongue and cheek. They don't cross the midline. After they rupture they leave small superficial areas of ulceration.

#### b) Chronic

### 1- Tuberculous Ulcer

- **Site:** Sides & tip of tongue due to autoinoculation from pulmonary T.B.
- **Size:** Small
- **Number:** multiple
- **Shape:** Oval, shallow
- **Pain:** Painful
- **Edge:** Undermined
- **Floor:** Contain pale yellow granulation tissue & tubercles
- **Base:** Soft
- **LN:** Enlargement of submandibular lymph node
- **Treatment:** antituberculous therapy & anesthetic paint.

### 2- Syphilitic Ulcer

- Occurs in the 3 stages of syphilis

#### A- Chancre

- Painless reddish indurated elevation which occurs on the dorsum near the tip, associated with gross painless enlargement of the submental and submandibular lymph nodes. The lesions full of spirochetes and heals in 6 weeks.

#### B- Secondary syphilis (snail track)

- The following lesions may be present:
  - Snail-track ulcer: multiple linear ulcers on the sides and undersurface of the tongue.
  - Mucous patches.
  - Hutchinson's wart: It is a condyloma at the midline of the dorsum of the tongue.
  - These lesions full of spirochetes and associated with cutaneous syphilis.

#### C- Tertiary Syphilis Gummatous ulcer

- The Gumma starts deep in the tongue nearly always in the midline. Finally it ulcerates on the dorsum leaving a punched out ulcer. Its floor is covered with a yellowish wash-leather slough.

### C- Leucoplakic ulcer

- Superficial ulcers resulting from desquamation of the keratinized layer leaving red glazed tongue.

### D- Malignant ulcer

- ➡ See tongue cancer

*iv. Neoplasm*

## 1 - Intra-oral Tumors

→ **Benign**

- Hemangioma.
- Lymphangioma.
- Papilloma.

→ **Premalignant**

- Leukoplakia.
- Xeroderma pigmentosa.
- Behcet's disease.

→ **Malignant**

- SCC of lips, **tongue**, palate, and gums.
- Malignant salivary gland tumors.
- Melanoma.
- Lymphoma.

## Carcinoma of the tongue

**Site**

- Lateral → 50%.
- Posterior 1/3 → 20%.
- Dorsum → 10%.
- Undersurface → 10%.
- Tip → 10%.

**Incidence**

- Male : female = 10 : 1
- More common in the 6<sup>th</sup> decade.

**Predisposing factors**

- **S**harp teeth, **S**pirits, **S**pices, **S**moking, **S**yphilis (3ry), Papilloma, leucoplakia.

**Pathology****A. MACROSCOPIC:**

- Malignant ulcer: deep irregular floor with necrotic tissue raised nodular everted edge & hard indurated base.
- Raised oval plaque.
- Hard submucosal nodule (less common).
- Deep indurated fissure.
- Diffuse infiltrating tumor (wooden base) is rare.
  - The surrounding mucus membrane may show leukoplakia)

**B. MICROSCOPIC:**

- Squamous cell carcinoma → 90%.
- Basal cell carcinoma or adenocarcinoma (from minor salivary glands) → rare.
- Posterior 1/3 tumors are less differentiated.

- ▶ **Site:** lat. Margin of ant. 2/3
- ▶ **Etiology:** **5S** (**S**harp teeth, **S**pirits, **S**pices, **S**moking, **S**yphilis)
- ▶ **Path.:** SCC (mass, nodule, fissure, ulcer)
- ▶ **C/P:** old ♂ - **Early:** asymptomatic or as path.  
- **Late:** pain, salivation, difficult speaking
- ▶ **Comp.:** as cancer + pneumonia + asphyxia
- ▶ **Invest.:** biopsy, CT
- ▶ **TTT:** surgery + radiotherapy ± adjuvant chemotherapy, palliative ttt in late cases



**Spread****a) Direct:**

- Floor of the mouth & mandible → posterior 1/3 → tonsils, pharynx & larynx.
- May cross midline to the other side of the tongue.

**b) Lymphatic:**

- Unlike SCC of the lip, SCC of the tongue spreads early to the LNs of the neck.
  - Tip → submental L.N → bilaterally to the submandibular and upper deep cervical LNs.
  - Margin → submandibular and upper deep cervical L.N of the same side.
  - Posterior 1/3 → directly to the upper deep cervical LNs.

**c) Blood:** (late) to the lung and bones. Usually the patient dies before this stage.**TN TM Staging**

- ▶ T0 No evidence of tumor.
- ▶ Tis Carcinoma in situ.
- ▶ T1 <2 cm.
- ▶ T2 2-4 cm.
- ▶ T3 >4 cm.
- ▶ T4 involvement of the base.
- N0 No LNs.
- N1 Ipsilateral single LN <3 cm.
- N2 Ipsilateral or contralateral LNs <6 cm.
- N3 LNs > 6 cm.
- ▶ M0 No metastases.
- ▶ M1 distant metastases.

**Clinical Picture**

- ➔ The classic clinical picture of tongue cancer is that an old man sitting in the outpatient clinic with cotton wool in his ear, and blood stained saliva dribbling from the mouth.

**Early cases**

- Symptomless.
- The patient may complain of persistent ulcer with indurated base and everted edge.

**Late presentation**

- Pain → Tongue: - 1<sup>st</sup> → due to infection,  
- Later → due to lingual nerve affection.  
→ Ear → referred by auriculo-temporal nerve.  
→ On swallowing: tumors of posterior 1/3
- Salivation: It may be blood stained and smells badly.
- Difficult speaking.
- Enlarged cervical LNs.
- Ankyloglossia.

### Complications

- Inhalation pneumonia.
- Infection and secondary hemorrhage.
- Cachexia due to starvation.
- Asphyxia.

### Investigations

- Biopsy.
- CT of neck and mandible.
- FNAC of suspected cervical LNs.

### Treatment

- ➔ Surgery and radiotherapy are the main lines of treatment.
- ➔ Chemotherapy is used as an adjuvant in some cases.

## A. Radical treatment of early cases

### Surgery

#### ► Indications:

1. Small growths T<sub>1</sub> and T<sub>2</sub>.
2. Incomplete regression or recurrence after radiotherapy.
3. Cancer on top of a precancerous lesion as leukoplakia.
4. Presence of the tumor very close to the mandible or infiltrating it.

#### ► Preoperative preparation

- Care of teeth and oral hygiene.
- Preoperative irradiation by 4000 rad may be advised.

#### ► Resection procedures

|                                   | Resection procedure                                                                                                                                             | Safety margin                   | Defect closure                                 |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------|
| <b>CIS</b>                        | Excision                                                                                                                                                        | 1 cm on sides & 0.5 cm in depth | Advancement mucosal flap on floor of the mouth |
| <b>Anterior 2/3</b>               | Partial glossectomy, hemiglossectomy or near total glossectomy                                                                                                  | 1.5 cm                          | Pectoralis major myocutaneous flap             |
| <b>Posterior 1/3</b>              | <ul style="list-style-type: none"> <li>► Total glossectomy (difficult access) → needs median mandibulotomy.</li> <li>► Irradiation</li> </ul>                   |                                 | Pectoralis major myocutaneous flap             |
| <b>Unilateral L.N. metastasis</b> | Complete neck dissection                                                                                                                                        |                                 |                                                |
| <b>Bilateral L.N. metastasis</b>  | <ul style="list-style-type: none"> <li>► Complete neck dissection.</li> <li>► Selective neck dissection on the less affected site preserving the IJV</li> </ul> |                                 |                                                |
| <b>Mandible</b>                   | <ul style="list-style-type: none"> <li>► Commando operation (combined mandibulectomy &amp; neck dissection operation)</li> </ul>                                |                                 | Osteomyocutaneous flap                         |

**Radiotherapy**► **Indications**

- T1 and T2 (less than 4cm) may equally benefit from surgery or radiotherapy.

► **Advantages**

- Avoiding the disfiguring side effects of surgery.

► **Disadvantages**

- Mucositis, dysphagia and osteoradionecrosis.

► **Methods**

- Brachytherapy → cesium or iridium needles.
- Teletherapy → external beam irradiation.

**B. Palliation for advanced cases**► **Indications**

- 1- Unresectable primary growth.
- 2- Fixed lymph nodes in the neck.
- 3- Distant metastases.

► **Methods**

- 1- Radiotherapy.
- 2- Palliative resection.
- 3- Analgesics, nasogastric feeding or tracheostomy may be required.
- 4- Chemotherapy.

**Prognosis**

- 1- TNM staging [**Lymph node involvement is the most important prognostic index**].
- 2- The degree of tumor differentiation. Poorly differentiated tumors develop local recurrence even if surgery and radiotherapy are combined.
- 3- Extension of the tumor posteriorly to the oropharynx carries bad prognosis
- 4- Combined surgery and radiotherapy improve prognosis.
- 5- Prognosis is better in females than males.

**2- Carcinoma of the cheek**

- As squamous cell carcinoma.

**Treatment****1- Radiotherapy:**

- Interstitial or external beam irradiation is the treatment of choice.

**2-Surgery:**

- Surgery is indicated for recurrent or residual tumors followed by reconstruction (as for the tongue cancer). Neck nodes as long as they are mobile are treated by neck dissection.



## 3- Miscellaneous

### Ranula

- It is a retention cyst arising from sublingual salivary gland.

#### Pathology

- The wall is composed of: thin fibrous capsule, which is lined by macrophages.
- Contains gelatinous material.
- If it extended down to the neck over the posterior margin of mylohyoid, it forms "plunging ranula".
- It may rupture & refill again.

#### D.D.

- Lingual dermoid cyst.
- Sublingual dermoid cyst.

#### C/P

- Cystic, bluish, and translucent swelling with prominent blood vessels over it and stretch submandibular duct.
- Overlying: covered by m.m. & crossed by Wharton's duct.
- May extend down in the neck → plunging ranula.

#### Treatment

- Marsupialization (deroofing) & suture cyst wall to oral mucous membrane
- Excision (difficult) in recurrent cases.



*Simple Ranula*

# Teeth, Gums & Jaws

## ▣ Jaw swellings

### *Jaw Swellings*

### Classification

#### Swellings of the jaw

#### 1) Bone tumors

##### I. Benign

- a. Osteoma
- b. Chondroma

c. Giant cell lesion of the jaw

##### II. Malignant

- a. Osteosarcoma
- b. Fibrosarcoma

- c. Secondaries
- d. Cancer maxilla

#### 2) Odontomes

"Cyst or cystic tumors related to development of teeth"

- A. Dental cyst
- B. Dentigerous cyst
- C. Adamantinoma "ameloblastoma"

#### 3) Epulides

Swelling of mucoperiosteum or gum

- A. Fibrous epulis
- B. Granulomatous epulis
- C. Myeloid epulis

- D. Sarcomatous epulis
- E. Carcinomatous epulis

### General scheme

#### 1- Common clinical picture:

- Toothache.
- Loose teeth.
- Hard swelling on the bone.
- Ulceration of the mucous membrane.
- Loss of sensation in the lower lip.

#### 2- Investigations:

##### a. Radiological:

- Plain X-ray: erosion & destruction of the underlying bone.
- Panorama.
- CT – MRI
- Angiography

##### b. Instrumental:

- Biopsy → (Incisional / Excisional.)
- Fine needle aspiration and cytology

#### 3- Treatment: According to etiology

## 1-Bone Tumors

### A-Benign tumors

- 1- Chondroma: see orthopedics
- 2- Osteoma: see orthopedics
- 3- Osteoclastoma: see orthopedics

### B-Malignant tumors

**A- Osteosarcoma**: see orthopedics

#### **B- Cancer maxilla**

- This is the commonest malignant tumor of maxilla.

#### Pathology

- It may be columnar cell carcinoma if it arises from the maxillary antrum or squamous cell carcinoma (less common) if it arises from the hard palate, gums or tooth sockets.
- The tumor spreads by infiltration of adjacent structures. Blood borne metastasis are rare.

#### Clinical picture

→ it is more common in young adults & elderly people. (♂=♀)

**Early**: → dull aching pain → referred to teeth → dental extraction.

**Late**:

C/O:

- |                                   |   |                    |
|-----------------------------------|---|--------------------|
| 1- Nasal obstruction on one side. | } | Medial wall        |
| 2- Epistaxis.                     |   |                    |
| 3- Swelling of the cheek.         | } | Anterolateral wall |
| 4- Epiphora.                      |   |                    |
| 5- Proptosis and diplopia         | } | Superior wall      |
|                                   |   |                    |

#### Investigations

1. **Plain X-ray**: Early: it shows opacity and increase in size of the antrum.  
Later: there is decalcification and erosion of the bone.
2. **CT scan and MRI**.
3. **Maxillary sinus endoscopy (sinuscopy) & biopsy**.

#### Treatment

- 1- **Early**: Complete excision of the maxilla.
- 2- **Late**: Localized excision of maxilla & irradiation as palliation

### **C- Secondaries**

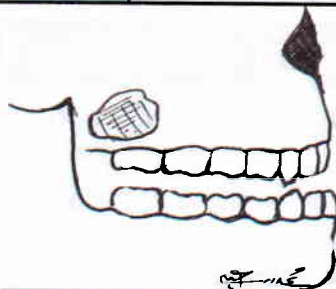
- Usually reach the maxilla by direct spread from nearby structure e.g. lip tongue & floor of the mouth

### Treatment

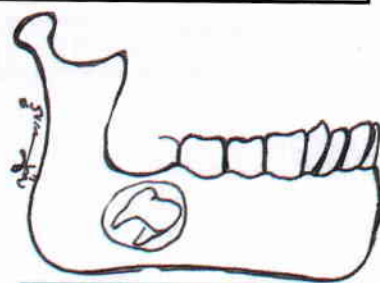
Treatment of 1ry + resection of mandible "no role of radiotherapy"

## 2-Odontomes (dental swellings)

|                       | A- Dental Cyst<br>(Radicular cyst)                                                                                                | B- Dentigerous Cyst                                                                                                                                              |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Origin</b>         | Paradental debris of Malassez                                                                                                     |                                                                                                                                                                  |
| <b>Etiology</b>       | <ul style="list-style-type: none"> <li>- Decayed tooth</li> <li>- Chronic inflammation</li> </ul>                                 | <ul style="list-style-type: none"> <li>- Missing 3<sup>rd</sup> molar</li> </ul>                                                                                 |
| <b>Pathology</b>      | <ul style="list-style-type: none"> <li>- Adults</li> <li>- In upper jaw.</li> <li>- Granulation tissue with exudation.</li> </ul> | <ul style="list-style-type: none"> <li>- <b>Children</b></li> <li>- <b>Lower jaw</b></li> <li>- Cystic enlargement with bone expansion &amp; thinning</li> </ul> |
| <b>Investigations</b> | <ul style="list-style-type: none"> <li>▪ X-ray</li> <li>- Doesn't contain a tooth</li> </ul>                                      | <ul style="list-style-type: none"> <li>- Contain a tooth</li> </ul>                                                                                              |
| <b>Treatment</b>      | Tooth extraction & curette of cyst                                                                                                |                                                                                                                                                                  |



Dental cyst



Dentigerous cyst

### C- Ameloblastoma (Adamantinoma) → old name

♀ with painless swelling, egg - shell crackling sensation, soap bubble appearance, ttt by excision

#### Pathology

- 1- Origin: ameloblasts "enamel-forming cells".
- 2- Site: at angle of Mandible & grows by both vertical & horizontal growth.
- 3- Macroscopic picture: **Solid** mass with **cystic** area & equal **lobulations**, white in color & well-capsulated with palisading arrangement.

#### Clinical Picture:

- Age & sex → female 20 – 40 years.
- Symptoms → painless progressive swelling of the angle of the mandible.
- Signs → egg - shell crackling sensation.

#### Complications:

- 1- Ulceration, infection, bleeding and falling of teeth.

- 2- Pathological fracture is rare.
- 3- It is liable to recurrence after inappropriate surgery.
- 4- Sometimes, it turns malignant → mixed tumor { Sarcoma  
Carcinoma

**Investigations:**

- X-Ray → (Soap - bubble appearance) honey coomb.
- CT scan and MRI.
- biopsy

**D.D.**

| <b>Adamantinoma</b>                                                                 | <b>Osteoclastoma (Giant cell tumour)</b> |
|-------------------------------------------------------------------------------------|------------------------------------------|
| At <b>a</b> ngle of Mandible                                                        | At symphysis menti                       |
| Both Horizontal & Vertical growth                                                   | Only Horizontal growth                   |
| Equal lobulations                                                                   | Unequal Lobulations                      |
| These lesions have the same clinical picture and are differentiated only by biopsy. |                                          |

**Treatment:**

- Excision + bone grafting.

### 3-Tumors of the Gum (Epulides)

*Epulis is a **mass** of the gum.*

**A- Fibrous epulis**

- Localized inflammatory hyperplasia of the gum mucosa due to chronic irritation.
- It is the commonest type.
- It is more common in the mandible between the incisors.

**Clinical Picture**

- Slowly growing, painless, firm swelling.
- It is covered by intact mucous membrane.

**Treatment**

- Teeth extraction & excision of tumour with wide base of mucoperiosteum

**B- Granulomatous epulis****Clinical Picture**

- Granulation tissue around a carious tooth.
- Red soft lobulated mass which bleeds easily on touch.

**Treatment**

- Excision of tissue & removal of causative tooth (histological examination is essential).



**C-Myeloid epulis****Clinical Picture**

- Affects the lower jaw more than the upper.
- Well - defined sessile swelling which is covered by intact mucous membrane and fixed to the underlying bone.
- It may cause serious hemorrhage.

**Treatment**

- Wide excision including a wedge of the gum & mandible.

**D- Carcinomatous epulis****Clinical Picture**

- **General** → cachexia, weight loss
- **Local** → fungating mass or malignant ulcer

**Treatment**

- Commando's operation.

**E- Sarcomatous epulis**

- Bad prognosis
- Blood spread .

**Clinical Picture**

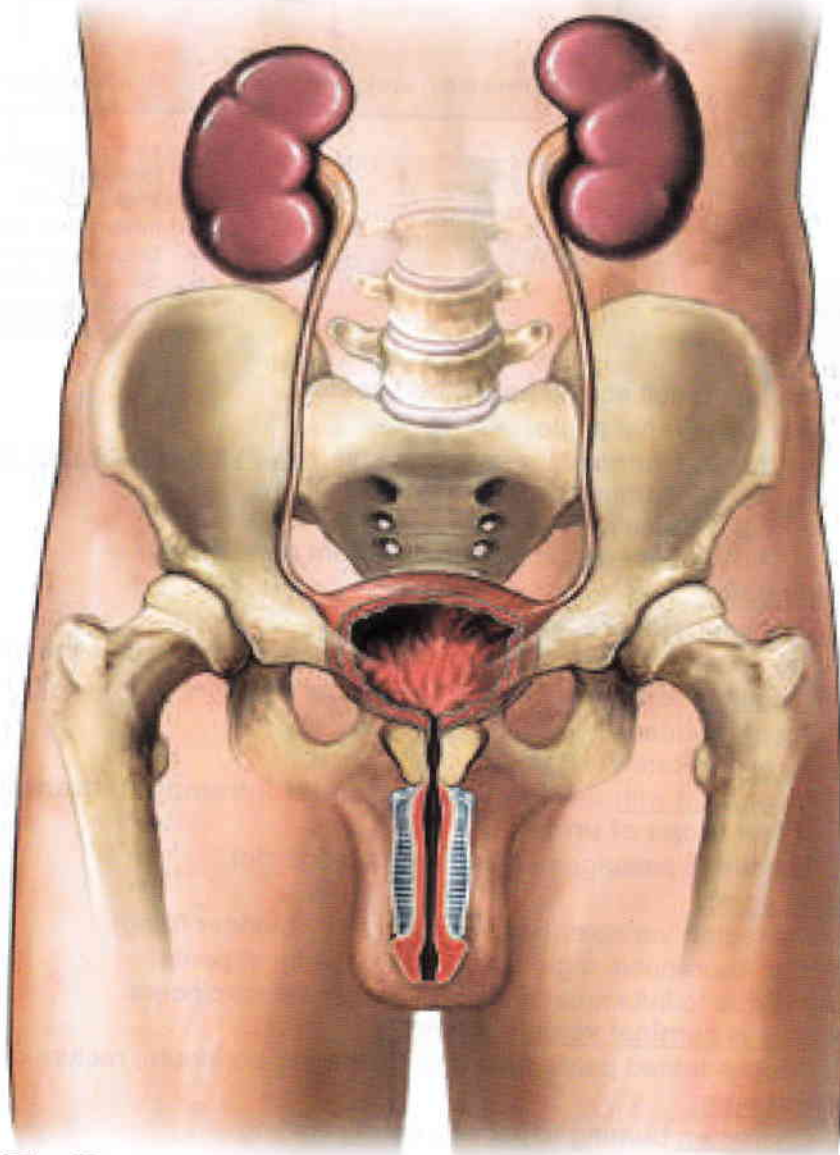
- Occurs in young age.
- Rapidly growing painful soft mass invading the surrounding structures.
- X-ray shows infiltration of the bone.

**Treatment**

- Commando's operation.

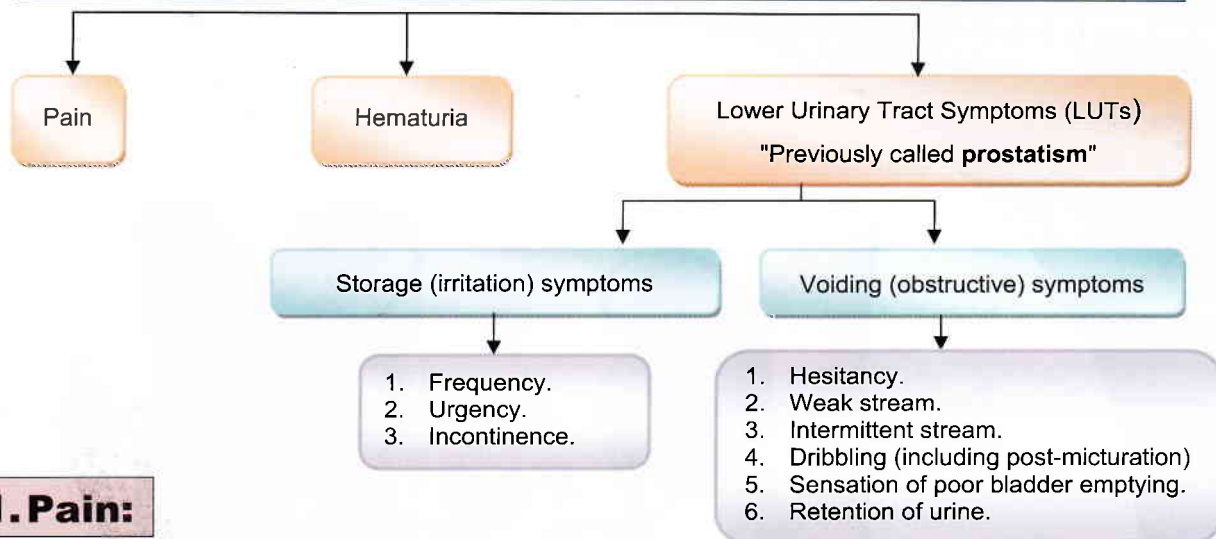
**C  
H  
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**4**



**UROSURGERY**

## Symptoms of the urological system



### 1. Pain:

#### a) Renal pain:

- Character: dull aching pain (deep-seated).
- Site: in the renal angle.
- It is due to stretch of the renal capsule, which may be caused by:
  - i. Inflammation.
  - ii. Calculi.
  - iii. Acute obstruction to flow from renal pelvis.

#### b) Ureteric colic:

- Character: **Severe agonizing pain.**
- Site: extends from loin to groin (**and to tip of penis if at the intramural ureter**).
- Radiation: to the ipsilateral iliac fossa and genitalia.
- Onset: Sudden.
- Duration: Rarely > 8 hours.
- Associated with nausea, vomiting **and if intramural; strangury (painful passage of few drops of urine).**
- It is due to passage of a stone or a blood clot.

#### c) Vesical pain:

- Character: variable (becomes worse by bladder filling).
- Site: suprapubic region, referred to the tip of penis.
- It is due to inflammation, stone or bladder carcinoma.

#### d) Prostatic & seminal vesicle's pain:

- Deeply-seated pelvic pain and referred to perineum, rectum or suprapubic area..

#### e) Urethral pain:

- Character: burning especially during voiding.
- Site: vulva or penis.

### 2. Frequency:

**Definition:** urine is passed more often than normal without increase in the total volume.

#### Types:

- Nocturnal: especially with BPH.

- Diurnal:

- Irritation of bladder wall (→ edema → ↓ physico-elastic properties of the bladder → ↓ capacity) e.g. stone or inflammation.
- Reduction in bladder capacity e.g. by a tumor.
- Detrusor instability.

**3. Urgency:**

Definition: It is a sudden strong desire to pass urine.

- Urgency alone may be due to anatomical changes as in gynecological prolapse or neurological disease.

**4. Oliguria:**

Definition: urine output < 400 ml/day.

Causes: causes of ARF.

**5. Urinary incontinence:**

Definition: uncontrolled escape of urine.

Types:

- True incontinence → defect in urethral sphincter.
- Stress incontinence → associated with physical strain.
- False incontinence (retention with overflow) → due to over-distended bladder.
- Urge incontinence → following urgency.

**6. Retention of urine:**

Definition: failure of bladder evacuation with working kidneys (**see later**).

**7. Hematuria:**

Definition: blood in urine.

**8. Other symptoms:****Chyluria:**

- The urine looks milky due to presence of lymph.
- The color clears on addition of ether.

**Necroturia:**

- Pieces of whitish substances appear in urine.
- They represent necrotic tissue of bladder carcinoma.

**Pneumaturia:**

- Presence of air bubbles in the urine.
- Usually due to vesico-colic fistula or infection with gas forming organism.

**Polyuria:**

Definition: ↑ urine output > 3L / day.

Causes:

a- Renal causes:

- 1- Nephrogenic diabetes insipidus (amyloidosis, hypokalemia, hypercalcemia)
- 2- Polyuric phase of ATN.
- 3- Diuretics.
- 4- CRF.

**b- Endocrinal causes:**

- 1- DM.
- 2- Cranial diabetes insipidus.
- 3- Cushing disease (hypokalemia, glycosuria).
- 4- Conn's disease (hypokalemia).
- 5- Hyperparathyroidism (hypercalcemia).

**c- Others:**

- 1- Psychogenic (compulsive water intake).
- 2- Drugs causing dry mouth as atropine → due to increase water intake.

**Hesitancy:**

**Definition:** difficulty to initial voiding.

## Investigations of urinary system

### 1. Laboratory

**1. Urine analysis:** (normal values)

- a) Volume: 500-1500 cc/day.
- b) Specific gravity: 1015-1025.
- c) Color: amber yellow, due to urochrome pigment.
- d) PH: 5.5-6.5 (acidic).
- e) Chemical contents:
  - Nitrogenous compounds.
  - Glucose & ketones → absent.
  - Small molecular weight proteins.
- f) Microscopic examination:
  - Cells: R.B.Cs (0-4/HPF), pus cells (0-4/HPF).
  - Bacteria, parasites, ova → absent.
  - Casts.

**2. KFTs:**

- a) Blood urea: 20-40 mg%.
- b) Serum creatinine: 0.5-1.5 mg%.
- c) BUN: 12-15 mg%.

**3. Tumor markers:**

- e.g. PSA, acid phosphatase (in carcinoma of the prostate).

### 2. Radiology

**1. Plain X-ray:** it shows:

- Stones (90% are radio-opaque except urate), nephrocalcinosis, calcified UB.
- Obliterated psoas shadow in perinephric abscess and renal injuries.

**2. Ultrasonography:**

- Confirms the site & size of the kidney.
- It can diagnose dilatation of the pelvi-calyceal system & thickness of renal cortex.
- Stones are easily visualized.
- Differentiate between cystic & solid lesion of the kidney.

**3. Renal scan:** static (DSMA) & dynamic (DTPA) for accurate renal function.



#### 4. Intravenous urography (IVU)= Intravenous pyelography (IVP):

- Procedure:
  - Urographin is given IV → kidney uptake → concentration → excretion.
- Value:
  - Anatomical description of the urinary system.
  - Stones, tumors (filling defect).
  - Rapid sequence IVP to diagnose renal artery stenosis.
  - Functional value:
    - Differential kidney function.
    - Vesico-ureteric reflux in voiding film.
- Non- visualization of kidney in IVP May be due to:
  - Congenital absence of kidney.
  - Shattered kidney.
  - Renal pedicle injury.
- Side effects:
  - Anaphylactic shock.
  - Acute renal failure (contrast nephropathy).
- Contraindications:
  - Renal impairment (blood urea > 50 mg %).
  - During or shortly after pain: as pain causes renal shutdown & we cannot access kidney function.

**IVU infusion method:** (to ↓ incidence of contrast nephropathy of the dye) → urogratin  
(2 ml/kg) + saline → infusion over 15 minutes

#### 5. Ascending pyelography (retrograde uretero-pyelography):

- If the renal function is impaired or if there is intraluminal lesion suspected.
- It is done through cystoscope & ureteric catheter.

#### 6. Cystography & urethrography:

- Descending: film of IVU.
- Ascending: through a catheter.

#### 7. Trans Rectal U/S (TRUS):

- For suspected prostatic carcinoma especially if PSA is high or abnormal prostatic outline on DRE.

#### 8. Renal arteriography:

- Mainly indicated to diagnose renal artery stenosis & A-V malformations.
- To differentiate between benign and malignant cysts:
  - If malignant → abnormal vascularity.
  - If benign → avascular.

#### 9. CT scan and MRI: for accurate evaluation of swellings.

## 3. Instrumental

#### 1. Endoscopy e.g. nephroscopy, ureteroscopy, cystoscopy & urethroscopy:

- Visualize stones.
- Visualize pathology of U.B mainly.
- Biopsy from any suspicious lesion.

#### 2. Biopsy: can be taken by endoscopes or by open surgery.

#### 3. Urodynamic studies: cystometry and flowmetry (for obstructive uropathy).

# Congenital anomalies

## i. Renal anomalies

### A- Solitary (simple) cyst of the kidney

#### Etiology

- Not clear whether the lesion is congenital or acquired. Its origin may be similar to polycystic kidney or may be related to tubular obstruction.

- ▶ **Path.:** 3F (fluid, flat epith., fibrous t.)
- ▶ **C/P:** asymptomatic, pain, swelling
- ▶ **Comp.:** as any cyst
- ▶ **Invest.:** U/S
- ▶ **TTT:** follow up, aspiration

#### Pathology

- **The cyst:**
  - Contains clear fluid & may contain altered blood.
  - Lined by flat epithelium.
  - Surrounded by fibrous tissue & **compressed** renal tissue.



#### Clinical picture

- **Usually asymptomatic.**
- Dull aching **pain** in the loin due to stretch of renal capsule.
- A **swelling** may be felt in the loin.
- Clinical picture of complications (e.g. hematuria, pyuria...etc.)

#### Complications

- Hemorrhage.
- Rupture, pressure on ureter (→ hydronephrosis).
- Infection & calcification.

#### Investigations

##### A- For Diagnosis:

1. **U/S is very helpful:**
2. **IVU:**
  - Smooth amputation of a calyx.
  - Localized smooth spider leg appearance.
3. **Renal angiography:** (not done now) → differentiate between cyst & tumor:
  - Cyst → avascular.
  - Tumor → abnormal vascularity.

##### The criteria of benign cyst:

Smooth wall, clear fluid, **no septa**, no malignant cell in aspirate, no residual mass after aspiration

##### B- For complications:

- Urine analysis: pus cells if infected.

#### Treatment

1. No treatment but follow up is required.
2. If the cyst cause hydronephrosis, treatment aspiration of the fluid in the cyst and sclerosing by 95% alcohol. Marsupialization or excision may be required.
3. Atypical cyst (hemorrhagic, thick wall or cloudy fluid):
  - Percutaneous needle aspiration of content for analysis. Blood, high fat content or positive cytology gives high suspicion of malignancy.
  - Excise the extrarenal portion of the cyst (Kirwin's operation).
  - Partial nephrectomy may be considered.

## B- Multi-cystic disease of the kidney

- Unilateral multi-cystic disease is much more common than polycystic kidney.
- Non hereditary disease.
- Associated with contralateral renal or ureteric abnormalities.
- It presents as non-functioning mass in the flank.
- Nephrectomy is the treatment of choice as neoplastic changes have been noted.

## C- Congenital polycystic kidney

### Definition

- Congenital enlargement of both kidneys by multiple cysts.

### Etiology

- Unknown cause → failure of fusion of mesonephric ducts with the metanephric ducts.
- The condition is usually familial with autosomal dominant inheritance (adult type), but slightly more common in females.
- It might be a part of cystic changes of the body (18% of patients have liver cysts, 30-40 % have intracranial aneurysms).

### Pathology

#### Site

- Always bilateral but one side is more affected than the other.

### Macroscopic

#### ⇒ Wall:

- Multiple cysts; not intercommunicated & are **not connected to the renal pelvis**.
- Surrounded by compressed atrophied renal tissue.

#### ⇒ Content:

- Amber clear fluid is the usual content.
- May be hemorrhagic or infected.

### Microscopic

- The cysts are lined by flattened epithelium.

### Clinical picture

The condition is not usually detectable on standard imaging until 2<sup>nd</sup> or 3<sup>rd</sup> decades of life and does not usually manifest itself before the age of 30 years.

- By 10 years old → no symptoms ( normal function and anatomy).
- From 10-30 years old → patient is asymptomatic but cysts could be demonstrated by U/S.
- After 30 years old:
  - Pain → dull-aching in flanks (stretch of capsule), severe if complicated.
  - Swelling → irregular upper quadrant abdominal mass (in the loin).

- ▶ **Types:** AD, AR
- ▶ **Path.:** Wall, content
- ▶ Not connected (together or with renal pelvis)
- ▶ **C/P:** age dependent
- ▶ **Comp.:** cyst + HTN + RF
- ▶ **Invest.:** U/S + comp. + screening
- ▶ **TTT:** medical & surgical

#### Types:

- 1- **Adult type:** AD inheritance. More common (see below)
- 2- **Infantile type:** AR inheritance, usually stillbirth or dies shortly after birth from uremia.



- Complications:

- Hematuria either microscopic or gross (due to rupture of cyst in the pelvis).
- Infection (due to stasis of urine).
- Hypertension (75%).
- Between 40-50 years old → renal function impairment.
- By > 50 years old → renal failure.

## Complications

### General

- Hypertension (75%).
- Renal failure.

### Local

- As any cyst (Infection - pressure atrophy - calcification - hemorrhage - rupture)

### DD

- Mass in renal angle (hydronephrosis, hypernephroma, liver swellings on the right side, splenomegaly on the left side).

## Investigations

### 1-For diagnosis

- U/S or CT scan → **most accurate** → multiple cysts in both kidneys.
- IVP → bilateral smooth spider leg appearance with elongated renal shadow.
- Cytological examination of cyst fluid obtained by fine needle aspiration.

### 2-For complications

- KFT (for renal failure).
- Urine analysis → hematuria or pyuria.
- Plain x-ray → calcification.

### 3-For screening (for other family members)

- U/S for family members above 20 years old.

## Treatment

### A-Treatment of congenital polycystic kidney:

1. **Medical:** to control the complications until renal transplantation is available.
  - Prevention of uremia → decrease proteins in diet.
  - Hypertension → ACE inhibitors.
  - Secondary infection → antibiotics.
  - Anemia → erythropoietin.
2. **Surgical:** **Rovsing operation (marsupialization) → rarely indicated:**
  - Puncture of cysts to diminish pain & pressure on the renal parenchyma.

Nephrectomy is contraindicated except if renal transplantation is possible

### B-Treatment of complications:

- Replacement therapy (for renal failure): Dialysis, kidney transplantation.

### C-Genetic counseling:

- For newly married couples planning to have children.

## Infantile polycystic kidney

- Very large kidneys may obstruct labour.
- Newborn with severe form of the disease may die from respiratory failure due to pulmonary hypoplasia or uremia.



## D- Other renal anomalies

### 1. Congenital fusion:

#### ➔ Horse-shoe kidney:

##### ✚ Pathology:

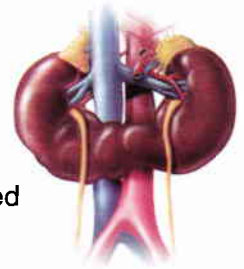
- Fusion occurs early in embryonic life when the kidneys lie low in the pelvis.
- Ascent of the kidney is arrested by the isthmus being blocked by the IMA.
- The renal pelvis lies on the anterior surface of the kidney.
- The ureters thus ride over the isthmus which connects the lower poles.

##### ✚ C/P:

1. 1/3 of the patients remain asymptomatic.
2. The rest develop symptoms of complications as pain, hematuria and fever.
3. A hydronephrotic horseshoe kidney may be palpable below the umbilicus.

##### ✚ Investigations: **IVU** → the kidneys are in lower position, the lower poles are nearer to the midline and the lower pole calyces point medially and lie medial to the ureter (**Flower vase appearance**<sup>v</sup>).

##### ✚ TTT: only if complicated & non functioning → division of isthmus at the level of inferior mesenteric artery (L3).

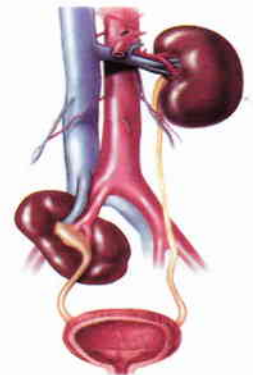


Horse Shoe kidney



### 2. Ectopic kidney:

- **Site:** usually near the pelvic brim and usually left sided.
- **Etiology:** failure of renal ascend & rotation.
- **Clinical picture:**
  - Gives mass in iliac fossa.
  - Renal ectopia may present diagnostic problems when acute disease develops in the kidney.
  - Surgeon may remove it by mistake as an unexplained pelvic mass.
- **Investigations:** **IVU** → ureter is short & straight.
- **DD:** abnormal mobile kidney (ptosed - floating).



Ectopic kidney

### 3. Aplasia.

### 4. Hypoplasia.

### 5. Dysplasia.

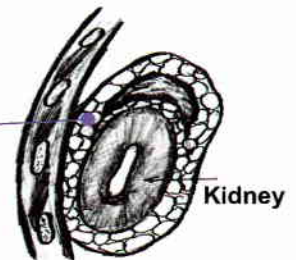
### 6. Abnormal mobile kidney:

- Normally both kidneys move up & down with respiration for 1 inch in the **Zücker Candle fascia**.
- Abnormal mobility may be:

#### [A] Floating kidney:

##### With mesentery

1. **Can be pushed** in all directions & **to the renal angle**.
2. **Complications:** torsion & gangrene (acute abdomen).





**[B] Ptosed kidney:**○ **Etiology:**

1. Wasting & regimens (↓ peri-renal fat).
2. Labor, pregnancy & repeated trauma.
3. Tight abdominal corset.

○ **Clinical picture:****Symptoms:**

- Mainly asymptomatic.
- GIT complaints → traction of **duodenum** → **distention** & vomiting.
- Urinary complaints:
  - 1- Loin pain & hematuria (**Deitl's crisis**).
  - 2- **Dragging** loin pain and firm mobile abdominal swelling.

**Signs: (during full inspiration)**

- **1st degree:** the lower ½ of the kidney is felt.
- **2nd degree:** the whole kidney is felt.
- **3rd degree:** floating kidney.

○ **Complications:**

- Stone.
- Infection.
- Hydronephrosis.

○ **Investigations:**- **IVU:**

- During full inspiration & expiration → mobility > 1 vertebra).
- Abnormal position + kinked ureter.

○ **Treatment:**

- Mainly conservative (weight gain, exercises & avoidance of corset).
- Surgical → nephropexy.

► **Etiology:** tight corset, wasting, repeated pregnancy and labor

► **C/P:** ASYMPTOMATIC +3D

► **Comp:** from urine stasis

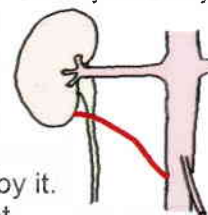
► **TTT:** conservative mainly + nephropexy

## E- Anomalies of renal vessels

### 1. Accessory renal artery:

- From renal artery → compress PUJ.
- Diagnosed by angiogram, IVU (transverse filling defect).

Accessory Renal Artery



### 2. Aberrant renal vessels:

- From aorta or common iliac, commonly on the left side.
- End-arteries, if divided → infarction of the area of medulla supplied by it.
- Renal veins, by contrast, have extensive collaterals and an aberrant vein can be divided.

## ii. Pelvi-ureteric anomalies

### Double ureter (Bifid pelvis):

- This is the most common anomaly of the upper urinary tract and is found in 4% of individuals.
- It is more common on the left side/ this lesion is harmless.



### iii. Anomalies of urinary bladder

#### A- Ectopia vesicae (Bladder Exstrophy)

##### Definition

A congenital anomaly characterized by absence of:

- The lower part of the anterior abdominal wall + anterior bladder wall.
- Usually associated with epispadias (**exstrophy-epispadias complex**).

##### Incidence

- 1:50000 live births.
- Male : female ratio = 4:1

##### Etiology

##### Theories:

1. Failure of union between the 2 sides of the bladder & 2 sides of the abdominal wall.
2. Intrauterine rupture of UB through ant. abd. wall due to delayed rupture of cloaca.

##### Clinical picture

##### 1. Absence of:

- Absent lower anterior abdominal wall.
- Umbilicus.
- Absent anterior bladder wall.

##### 2. Widening of symphysis pubis → waddling gait.

##### 3. Genitalia:

**In male:** epispadias (exstrophy-epispadias complex) + rudimentary prostate, seminal vesicles and penis (broad & short) + bifid scrotum + bilateral undescended testes ± bilateral inguinal hernia.

**In female:** bifid clitoris + anterior separation of labia minora → exposed vaginal orifice.

##### 4. Associated anomalies: e.g. spina bifida, cleft lip.

##### Complications

1. Cystitis & ascending pyelonephritis → death before 30 years.
2. Skin excoriation & ammoniacal odour.
3. Ulceration & bleeding from exposed bladder mucosa.
4. Chronic irritation of bladder mucosa → bladder carcinoma.

##### Investigations

- Antenatal diagnosis is possible by ultrasound.
- **Plain X-ray:** wide separation of the symphysis pubis.
- **IVU:** for associated urinary tract anomalies.

##### Treatment

##### A. Complete reconstruction:

- **At birth** → temporary closure of defect + drainage to preserve renal function.
- **Later on** → bladder augmentation to increase size and preserve continence (appendix can be used for augmentation)
- **Pelvic reconstruction** → by corrective osteotomy.

##### B. If continence cannot be preserved → permanent diversion (ureterosigmoidostomy or ileal conduit).

▶ A congenital anomaly of unknown etiology which is common in males

##### ▶ C/P

- a. The bladder mucosa is exposed due to Absence of anterior bladder wall, umbilicus & lower anterior abd. wall
- b. waddling gait
- c. Anomalies in genitalia

▶ **Comp.:** infection, bleeding, chronic irritation

▶ **Invest:** X RAY, IVU

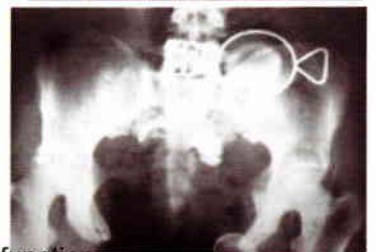
▶ **TTT:** surgical reconstruction



**Rudimentary penis, undescended testes with bifid scrotum**



**Metaplasia of exposed mucosa**



## B- Urinary bladder diverticulae

### Definition

- A bladder diverticulum is a flask-shaped protrusion through the muscle wall of the urinary bladder.

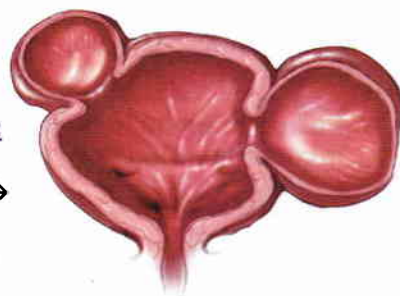
### Etiology

#### 1. Congenital diverticulum:

- Rare (represent unobliterated vesical end of urachus).
- Solitary → located medial to and above the ureteric orifice (midline antero-superiorly).
- Rarely multiple.
- It has muscle fibers within its wall → contractile.

#### 2. Acquired diverticulae (Pulsion diverticulae):

- Often multiple.
- Always associated with distal obstruction → trabeculation & sacculation of the bladder.
- There are no muscle fibers in the fundus and they do not empty during micturation.



- ▶ It may be congenital or acquired (pulsion diverticulum)
- ▶ **C/P:** - An old male patient usually with no specific symptoms and discovered on U/S  
- Double micturation
- ▶ **Comp.:** due to urine stasis (infection, stone .....)
- ▶ **Inv:** cystography
- ▶ **TTT:** Diverticulectomy

Traction diverticulum = hernia of bladder through inguinal or femoral hernia = sliding hernia

### Clinical Features

- The patient is almost always male 95% over 50 years.
- No specific symptoms (usually accidentally discovered on U/S or cystoscopy).
- In congenital type: may be filled with urine during micturation → empty into UB → produce an immediate desire to pass urine (**double micturation**), the second may follow a change of posture).
- Complicated diverticulae will rise to frequency, pain and hematuria.

### Complications

⇒ Stagnation of urine in the diverticulum may result in:

- Infection (recurrent).
- Stone formation.
- Hydroureter and hydronephrosis (extremely rare and is a consequence of peri-diverticular inflammation and fibrosis).
- Squamous metaplasia.
- Rarely, a squamous cell carcinoma (< 5%).

### Diagnosis

1. **Cystography:** descending (= IVU) or ascending → demonstrates the diverticulae.
2. **Cystoscopy:** → demonstrates diverticular openings within UB.

### Treatment

- Diverticulectomy (only if complicated or producing ureteric obstruction).
- Treatment of the cause.



## C- Bladder neck obstruction (BNO, Marion's disease)

### Incidence

- Usually occurs in men, but can rarely affect children of both sexes.

### Etiology & Pathology

#### 1. Due to muscle hypertrophy:

- Muscular hypertrophy of the internal sphincter in a young person with the development of a vesical diverticulum or hydronephrosis (**Marion's disease**).

#### 2. Due to fibrosis of tissues at the bladder neck:

- Symptoms similar to those of prostatic enlargement, due to scarring after TURP.

### Investigation

- Urodynamic study → demonstrates raised voiding pressures and diminished flow rate.

### Treatment

#### 1- Medical

##### ↳ Alpha-blocking drugs:

- Doxazosin, Prazosin, Terazosin (highly effective).
- These drugs are not target specific and the patients must be warned of the possibility of postural hypotension.

#### 2- Surgical

##### ↳ Transurethral incision:

- Transurethral incision of the bladder neck is the operation of choice.
- Recurrence may occur, due to inadequate division of bladder neck fibers.

## iv. Anomalies of the urethra

### A- Epispadias

### Definition

- A congenital anomaly of the urethra in which the urethra opens on the dorsal surface of penis associated with upward curvature of the penis.

### Incidence

- Male → 1:120,000.
- Female → 1:500,000.

### Pathology

#### 1. Incomplete type:

- Subdivided into → glanular, mid-penile or peno-pubic.
- The patient is continent.

#### 2. Complete type:

- The condition is associated with ectopia vesica (exstrophy-epispadias complex).
- The patient is incontinent.



### Treatment

1. Incomplete type: as hypospadias (within 7 years) but on the dorsum of the penis.
2. Complete type: as ectopia vesica.

## B- Hypospadias

### Definition

- A congenital anomaly of the urethra in which the urethra opens on the under surface of penis or perineum and the ventral surface of prepuce is poorly developed.

- ▶ The urethra opens on the under surface of penis
- ▶ Commonest congenital anomaly of the urethra
- ▶ Glandular type is the commonest type of hypospadias
- ▶ **C/P**: Depends on the age of patient
- ▶ **TTT**: circumcision should be avoided till surgical correction.

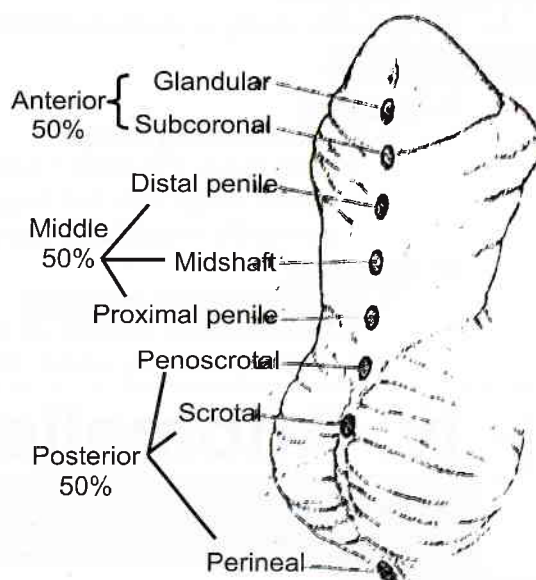
### Incidence

- 1:150 – 300 boys.
- **The commonest congenital anomaly of urethra.**
- Positive family history in 8% of cases.

### Types

1. **Glandular type (commonest)** → EUM opens on under surface of the glans.
2. **Coronal Meatus** is at the coronal sulcus.
3. **Penile type**:
  - EUM opens on the under surface of the shaft of the penis. It may be:
    - A- Anterior penile.
    - B- Mid-penile.
    - C- Posterior penile (peno-scrotal).
  - The distal part of urethra (corpus spongiosum distal to the urethral opening) is replaced by fibrous band.
  - This fibrous band is known as **urethral chordee**.
  - It causes curving of the penis downward on erection.
4. **Penoscrotal**.
5. **Perineal type**:
  - The scrotum is split.
  - The urethra opens between its 2 halves.
  - The penis is rudimentary.
  - The testes may be undescended.

- ▶ Hypospadias is anterior in 65% of cases, midpenile in 15%, and penoscrotal or perineal in 20% of cases.



### Etiology

1. **Glandular type**: occurs due to failure of re-canalization at the glans of penis.
2. **Penile type**: occurs due to failure of fusion of inner urethral folds.
3. **Perineal type**: occurs due to failure of development of whole penile urethra.

### Clinical picture

Depends on age of patient and severity of disease:

- **At birth**:
  - Abnormal prepuce present dorsally only (**hooded prepuce**).
  - Urethral opening more proximal than usual.



- **2-10 years:** wetting the clothes in micturation (abnormal stream).
- **10% of patients** have inguinal hernia or undescended testis.
- **8% of patients** have upper urinary tract anomalies.
- **After puberty:**
  - Bowing of penis downwards during erection due to presence of fibrous chordee.

Glanular type is a psychological concern, while other types will impair the function

## Complications

- Psychological distress.
- Pseudo infertility.
- Dyspareunia.
- Associated hormonal manifestations (rare).

## Investigations

### a. For associated conditions:

- Hormonal assay and karyotyping (if bilateral undescended testes with hypospadias).

### b. To assess success of surgery:

- Ascending urethrogram postoperatively.

## Treatment

Circumcision should be avoided in all cases of hypospadias as the skin of the prepuce may be used in the repair later on

⇒ **Timing:** at 6-18 months → improved emotional and psychic results.

⇒ **Aim:**

- Straight urine stream → psychological and social concern.
- Correction of bowing of the penis → correct sexual function.

⇒ **Principle:**

- 1- Removal of the chordee to correct the ventral curvature.
- 2- Urethral reconstruction using skin from the prepuce or penile skin.
- 3- Circumcision after that.

## C- Other anomalies of the urethra

⇒ **Phimosis**

- Congenital contraction of the prepuce which **will not retract** over the glans resulting in "pin hole" meatus & lower urinary tract obstruction.
- It may be acquired as in balanitis xerotica obliterans.
- **Treatment:** circumcision.

⇒ **Paraphimosis**

- The prepuce becomes tightly retracted beyond the base of the glans or on the shaft of the penis.

⇒ **Urethral stricture**

⇒ **Anterior urethral valve**

⇒ **Posterior urethral valve**

- Obstruction is caused by congenital valve in the posterior urethra causing a severe form of obstructive uropathy.



### ➤ Clinical picture

#### ☞ Symptoms:

- Antenatal diagnosis → bilateral hydronephrosis.
- In neonatal period → poor stream, acidosis, and raised blood urea.
- Urinary tract infection in the dilated system resulting in septicemia.
- Older children → poor urinary stream, hematuria, or retention of urine.

#### ☞ Signs:

- It shows a distended bladder and palpable kidneys.

### ➤ Investigations

- **Ultrasound** → dilatation of pelvi-calyceal system, thinning of the cortex, distended bladder and dilated ureter.
- **Micturating cysto-urethrogram** → shows distended posterior urethra, vesico-ureteric reflux, bladder trabeculation and diverticulae.
- **Renal function tests:** for complications.

### ➤ Management

Depends on the renal function and general condition of the patient (neonate):

#### 1- **Emergency measures to relieve obstruction and improve renal function:**

- a- Insertion of urethral catheter to drain the bladder and bypass the obstruction.
- b- Resuscitation → correction of the dehydration, acidosis, and antibiotic prophylaxis.

#### 2- **Definitive treatment:** when the renal function improves:

- a. If there is available urethroscope to deal with neonatal urethra → **endoscopic Electro-fulguration** of the valve is the ideal treatment.
- b. If not available → urinary diversion (usually vesicostomy or ureterostomy occasionally) is done until it is possible to fulgurate the valve endoscopically.

## Urinary tract injuries

### General considerations

- About 10 % of all injuries seen in the casualty department involve the urinary system.
- Renal injuries are the most common of them.

### Types of trauma

- Many types of trauma such as:
  - **Blunt injuries:** motor car accident, falling from height.
  - **Penetrating injuries:** stab wound, bullets.
  - **Iatrogenic injuries:**
    - During operation.
    - Endoscopic urological procedures.
    - After radiotherapy on the pelvis.

## A- Injuries of the kidney

### Incidence

➔ **Injuries of the kidney are relatively rare due to:**

- 1- The kidneys are well protected by the rib cage & by the heavy muscles of the back.
- 2- The kidneys are mobile in their adipose fat & thus flee away from the force of trauma.
- 3- The fibrous capsule does protect the parenchyma from splitting.

➔ Renal injuries are potentially serious & may be complicated by injuries of other organs.

- ▶ Blunt, Penetrating, Iatrogenic
- ▶ **Path:** 3tear, 2avulsion, 2blood
- ▶ **Symp:** Pain+hematuria+comp.
- ▶ **Signs:** Shock + Bad abdomen
- ▶ **Comp.:** 4osis + 2Balls + HTN
- ▶ **Invest.:** U/S + CT + IVP
- ▶ **TTT:** conservative, surgery

### Etiology

- 1- Blunt injuries are the commonest (80-85%) due to :
  - Direct trauma to the abdomen (common), flank or back e.g. car accidents.
  - Indirect (less common) or contre coup injury, e.g., falling from a height & landing on the feet or buttocks.
- 2- Penetrating wounds e.g. knives or bullets are rare. Associated visceral injuries are present in 80% of renal penetrating wounds.
- 3- Iatrogenic injuries occur during surgery.

### Pathology

*Renal injury may be one of the following degrees:*

1. **Brusing and ecchymosis** are the most frequent.
2. **Superficial tear:**
  - Affects the cortex.
  - This leads to subcapsular hematoma or perinephric hematoma.
3. **Deep tear:**
  - Affects the medulla.
  - This leads to hematuria.
4. **Complete tear:**
  - Extends from the capsule to the renal pelvis.
  - This leads to perinephric hematoma & hematuria.
5. **Avulsion of a pole.**
6. **Avulsion of the pedicle.**
7. **Subcapsular hematoma.**
8. **Associated injuries.**



Superficial tear



Deep tear



Complete tear



Subcapsular hematoma



Avulsion

## Clinical picture

### Symptoms

1. History of trauma.
2. Pain in the flanks. It may be obscured by injury to other organs.
3. **Hematuria: (*degree is not proportionate to severity*)**
  - It may appear some hours after injury.
  - It can occur between third day and third week after the accident (due to clot becoming dislodged → sudden profuse hematuria).
  - About 30% of vascular injuries are not associated with hematuria.

#### May be absent in:

- Superficial tear.
  - Avulsed pedicle or ureter.
  - Clot retention (→ ureteric colic).
  - Traumatic anuria.
  - Severe hypotension.
4. **Meteorism:** abdominal distension, N&V 24-48 hours after renal injury is probably due to retroperitoneal hematoma involving splanchnic nerves (resembling paralytic ileus).
  5. **Oliguria** due to hypovolemia and hypotension.
  6. **Retention of urine** due to clots in the bladder.



### Signs

#### **A-General:**

1. **Shock:**
  - Irritability, pallor.
  - Sweating, subnormal temperature.
  - Low B.P.
  - Rapid weak pulse.
2. **Associated injuries:** (e.g. fracture lower ribs ± pneumothorax).

#### **B-Local:**

#### Abdominal examination:

##### 1. Inspection:

- Ecchymosis & bruises in the loin.
- Fracture ribs.
- Rigidity.
- Hematuria in collected urine samples.

##### 2. Palpation:

- Tenderness in the loin.
- Loin swelling due to extravasation of blood & urine.
- If the peritoneum is torn → diffuse abdominal tenderness and distention.
- Manifestations of intra-peritoneal hemorrhage (guarding, rebound tenderness).

##### 3. Percussion: shifting dullness.

##### 4. Auscultation: ↓ Intestinal sounds.

##### 5. DRE: fullness in recto-vesical pouch (or Douglas pouch in females).

Rupture kidney may be retroperitoneal with minimal shock with no peritoneal irritation.



## Complications

### Early

1. **Anuria** → may be due to:
  - a. Shock.
  - b. Reflex inhibition of both kidneys.
  - c. Clot retention (due to obstruction of the bladder outflow by blood clots).
  - d. Injured solitary kidney.
2. **Bad general condition** → Hemorrhage & shock.

### Late

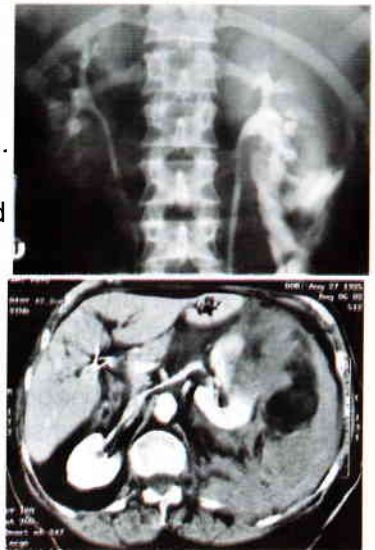
- 1- **Pseudohydronephrosis** few weeks after injury due to:
  - Deep tear in the kidney + ureteric obstruction associated (caused by scarring).
- 2- **Perinephric abscess.**
- 3- **Nephroptosis** due to tear of the supporting tissues.
- 4- **Hypertension** after few months due to renal fibrosis.
- 5- **Renal artery aneurysm** (if injured alone), **A-V fistula** (if both A. & V. are injured).
- 6- **Hydronephrosis** due to fibrosis around the kidney leading to ureteric obstruction.
- 7- **Renal atrophy or fibrosis.**

## Investigations

**Better to resuscitate the patient 1<sup>st</sup> (anti-shock measures):**  
 O<sub>2</sub>, Ryle, 2 IV lines, IV fluids or blood transfusion and urinary catheter

### For diagnosis

1. **U/S**: perinephric hematoma and/or free blood.
2. **CT scan**: if doubtful diagnosis.
3. **Angiography or Tc scan**: for vascular or minimal injuries.
4. **Plain x-ray**:
  - Shows any foreign body, fracture ribs or associated hemothorax.
  - Obliterated psoas shadow from the hematoma.
5. **IVU infusion urography**:
  - Is done to visualize the upper urinary tract as soon as the shock is controlled & the blood pressure is above 100mm Hg. It may show :
    - Normal function & configuration of kidney if the injury is minimal.
    - Deformed renal pelvis or calyces if there is laceration or blood clots.
    - Extravasation of contrast within the renal shadow or into perirenal space.
    - Non visualization of kidney due to total pedicle avulsion, arterial thrombosis or severe contusion causing vascular spasm.
    - Confirms the presence of a functioning kidney on the opposite side, as nephrectomy of the injured kidney may be needed.





## For complications

1. Urine analysis → RBCs...etc.
2. KFTs.
3. CBC, FBS.

## Treatment

- **General** → If the patient is poly-traumatized: ABCDE  
→ Treatment of shock.
- **Specific** → Conservative management 85% of cases.  
→ Surgical management if indicated.
- Treatment of associated injuries and other complications.

- ➔ Renal trauma is an acute emergency.
- ➔ Most renal injuries will be cured by conservative management, as most injuries (85%) are minor.
- ➔ The principles of trauma victims care should be followed.

### A. Conservative treatment:

- Hospitalization with bed rest until hematuria has stopped & local signs of injury have subsided.
- Analgesics for pain.
- Large fluid intake to guard against clot retention & for hypovolemia.
- Broad spectrum antibiotics to guard against secondary infection.
- **Follow up parameters:**
  - Pulse, blood pressure, & size of any peri-renal mass.
  - Repeated samples of urine are examined & compared grossly for red color.
  - Hemoglobin & hematocrit estimations.
  - Repeated urine analysis for RBCs.

### B. Surgical treatment:

#### ⇒ Indication:

1. Persistent progressive hematuria or failure to stabilize vital signs.
2. Presence of a progressively enlarging peri-renal mass.
3. Evidence of peri-renal infection.
4. Penetrating injuries.
5. Renal pedicle injury (5% of all injuries).
6. Presence of an associated intraperitoneal injury.
7. Indications for delayed surgery:
  - If hydronephrosis develops → it is treated by relief of obstruction.
  - If hypertension develops → vascular repair or nephrectomy is performed.

#### ⇒ Principles:

- 1- Transperitoneal approach.
- 2- Traumatized & devascularized renal tissue is debrided.
- 3- Small defects of cortical tissue are sutured. Large defects are filled by omental or perirenal fat to obliterate dead space.
- 4- Water-tight closure of the pelvi-calyceal system.
- 5- Partial nephrectomy is done if one pole of the kidney is avulsed.
- 6- Nephrectomy is done if the kidney is shattered or with complete avulsion of vascular pedicle, provided that the other kidney is functioning well.



**C. Treatment of complications:**

- A. **Associated injuries.**
- B. **Perinephric abscess** → drainage + antibiotics.
- C. **Hypertension** → usually refractive to medical treatment & nephrectomy may be needed.
- D. **Clot retention** → bladder washout through a catheter or a cystoscope.
- E. **Aneurysm of renal artery** → excision or urgent nephrectomy if the other kidney is normal (to avoid fatal rupture of the aneurysm).

**B- Injuries of the Ureter****Etiology**

1. **Open injury:** stab wound, gunshot...etc.
2. **Closed injury:** e.g. kick or hyperextension of the spine...etc.
3. **Iatrogenic:**
  - Most common cause.
  - May occur during open surgery especially pelvic surgery e.g. hysterectomy (division, ligation, crushing or excision) or endoscopic surgery (perforation).
  - Ureteric catheterization may help to see the ureters and avoid them during surgery.
  - It may follow pelvic irradiation.

- ▶ Mostly iatrogenic during pelvic surgery
- ▶ C/P: a. **unilateral** (loin pain, swelling, silent atrophy the worst presentation)  
b. **Bilateral** (anuria, oliguria)
- ▶ Inv: CT with contrast, excretion urography
- ▶ TTT: A- restoration of uretero-vesical continuity for immediately diagnosed and fair patient  
B- Nephrostomy tube for poor patient and in delayed diagnosis then repair

**Diagnosis****A. Unilateral injury**

- There are three possibilities:
  1. No symptoms.
  2. Secure ligation of a ureter may simply lead to silent atrophy of the kidney.
  3. Loin pain & swelling.
  4. Fever, possibly with pyonephrosis secondary to obstruction.
  5. A urinary fistula may develop through the abdominal or vaginal wound.

**B. Bilateral injury**

- Leads to → anuria or oliguria.

**Investigations**

1. **Excretion urography or ascending retrograde urography** → obstruction or extravasation.
2. **CT scan with contrast** → extravasation of the dye.

**Treatment****I- If immediate diagnosis:**

- **Fair patient condition** → uretero-vesical continuity should be restored by 1<sup>st</sup> anastomosis.
- **Poor patient condition** → deliberate ligation of the proximal end of the ureter + nephrostomy for drainage of urine → delayed repair.

**II- If delayed diagnosis:**

- Temporary nephrostomy → delayed repair (when the edema subsides).

### TYPES OF REPAIR

1. If no loss of length (and the cut ends of the ureter can be brought together without tension) → primary end-to-end anastomosis over a double pigtail catheter.
2. If there is little loss of length (division is very low down):
  - a. **Psoas hitch of bladder:** re-implantation of the ureter into the bladder.
  - b. **Boari's operation:** a flap of bladder wall is fashioned into a tube to replace the lower ureter.
3. If there is marked loss of length:
  - a. **Uretero-ureterostomy:** end-to-side implantation of the ureter into the contralateral ureter.
  - b. **Replacement** of the damaged ureter by a segment of ileum or mobilized appendix.
  - c. **Nephrectomy:** when the patient's outcome is poor and the other kidney is normal.

## C- Injuries of the bladder

### Types

1. Intra-peritoneal rupture of the bladder.
2. Extra-peritoneal rupture of the bladder (DD → intra-pelvic rupture of membranous urethra).

|               | Intra-peritoneal rupture (20%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Extra-peritoneal rupture (80%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Causes        | <ul style="list-style-type: none"> <li>- Occurs in males &gt; females.</li> <li>- Full bladder &amp; direct trauma applied to supra-pubic region.</li> <li>- Surgical injury.</li> </ul>                                                                                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>- More in males.</li> <li>- Bladder is injured 2<sup>ry</sup> to fracture pelvis.</li> <li>- Surgical injury is rare.</li> </ul>                                                                                                                                                                                                                                                                                                                                              |
| Pathology     | <ul style="list-style-type: none"> <li>- Sterile urine escapes into peritoneal cavity → peritonism → delayed peritonitis.</li> <li>- Rupture usually occurs between the roof and post wall of the bladder.</li> </ul>                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>- Urine extravasates into the peri-vesical &amp; peri-prostatic spaces, retro-pubic space (cave of Retzius) and then ascends up between peritoneum &amp; fascia transversalis.</li> </ul>                                                                                                                                                                                                                                                                                     |
| Symptoms      | <ul style="list-style-type: none"> <li>▪ History of trauma.</li> <li>▪ Supra-pubic pain.</li> <li>▪ Urine retention with <b>NO</b> desire to micturation in intra-peritoneal type, but the desire is preserved in extra-peritoneal type.</li> <li>▪ Hematuria.</li> </ul>                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Signs         | <ul style="list-style-type: none"> <li>▪ <b>General:</b> shock.</li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li><b>Inspection:</b> bruises, ecchymosis &amp; rigidity</li> <li><b>Palpation:</b> guarding, rebound tenderness</li> <li><b>Percussion:</b> shifting dullness</li> <li><b>Auscultation:</b> diminished intestinal sounds</li> <li><b>DRE:</b> fullness in recto-vesical pouch</li> </ul> </li> </ul> <p>Catheter can be passed easily &amp; no urine is obtained (only blood)</p> | <ul style="list-style-type: none"> <li>▪ <b>General:</b> shock.</li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li><b>Inspection:</b> bruises, ecchymosis &amp; rigidity in supra-pubic region due to fracture pelvis.</li> <li><b>Palpation:</b> guarding, rebound tenderness in supra-pubic region.</li> <li><b>Percussion:</b> no shifting dullness.</li> <li><b>DRE:</b> empty recto-vesical pouch.</li> </ul> </li> </ul> <p>Catheter can be passed easily &amp; blood + small amount of urine</p> |
| complications | <ul style="list-style-type: none"> <li>• Pelvic abscess from infection of hematoma or urine collected.</li> <li>• Delayed peritonitis.</li> <li>• Partial incontinence if bladder neck is injured.</li> </ul>                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Investigations | <b>1-X-ray</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |
|                | Ground glass appearance (due to urine in the lower part of the abdomen).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Fracture pelvis. |
|                | <b>2-U/S &amp; CT scan:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
|                | Free fluid in peritoneum → peritoneal tap may be of value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |
| Treatment      | <b>3- Ascending cystography or IVU</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |
|                | Leaking of the dye from the urinary bladder                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
|                | <ul style="list-style-type: none"> <li>• If the patient is poly-traumatized → ABCDE + secondary survey.</li> <li>• Treatment of shock: Ryle, IV line, I.V fluids or blood).</li> <li>• Treatment of associated injuries if present.</li> <li>• <u>Treatment of ruptured bladder:</u> <ul style="list-style-type: none"> <li>- Through a <b>midline</b> supra-pubic incision.</li> <li>- The extravasated urine is evacuated.</li> <li>- The bladder is exposed and sutured with a single layer of 2/0 polygalactin 910 or double layered catgut.</li> <li>- Placement of a supra-pubic drain, retro-pubic drain and urethral catheter.</li> </ul> </li> </ul> |                  |
|                | <p><b>N.B.</b> surgical bladder injury → immediate repair + urethral drainage for 7 days.</p> <p><b>N.B.</b> The fractured pelvis should not be treated by internal fixation in the presence of urine extravasation for fear of osteomyelitis.</p>                                                                                                                                                                                                                                                                                                                                                                                                            |                  |

## D- Injuries of the urethra

### Types

#### According to site

1. **Extra-pelvic** (anterior, bulbous or penile urethra).
2. **Intra-pelvic** (posterior, membranous urethra) → DD extra-peritoneal rupture of bladder.

|           | Extra-pelvic rupture (most common)                                                                                                                                                                                                                                                                             | Intra-pelvic rupture                                                                                                                                                                                                                                                                                                                                            |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cause     | Trauma to perineum<br>(Falling astride or kick).                                                                                                                                                                                                                                                               | - Iatrogenic by catheterization<br>- 2 <sup>ry</sup> to fracture pelvis                                                                                                                                                                                                                                                                                         |
| Pathology | <ul style="list-style-type: none"> <li>• The tear may be partial or complete.</li> <li>• The urine collects under Camper's, Scarpa's &amp; Colle's fasciae at the penis, perineum, scrotum, anterior abdominal wall &amp; then descends down to the upper part of the thigh.</li> </ul>                        | <ul style="list-style-type: none"> <li>• Tear of the urethra, which is usually complete.</li> <li>• Avulsion of the pubo-prostatic ligament → <b>floating prostate</b>.</li> <li>• Extravasation of urine (in the cave of Retzius).</li> </ul>                                                                                                                  |
| Symptoms  | <p><b>Severe pain in perineum.</b></p> <p>History of trauma.<br/>Urine retention with desire to micturation.<br/>Urethral bleeding.<br/>The triad of urethral hemorrhage, perineal hematoma and retention of urine is diagnostic of extra-pelvic rupture.</p>                                                  |                                                                                                                                                                                                                                                                                                                                                                 |
| Signs     | <ul style="list-style-type: none"> <li>▪ <b>General:</b> Shock.</li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li>- Perineal hematoma</li> <li>- Bleeding per urethra.</li> <li>- Bladder is full.</li> <li>- <b>Catheter is never used</b> if urethral injury suspected.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>▪ <b>General:</b> Shock.</li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li>- Fracture pelvis</li> <li>- Bleeding per urethra.</li> <li>- Bladder is full.</li> <li>- <b>Catheter is never used</b> if urethral injury is suspected.</li> <li>- <b>PR: prostate</b> can not be felt.</li> </ul> </li> </ul> |



|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                         |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Complications  | I. <u>Subcutaneous extravasation in complete rupture.</u><br>II. <u>Stricture.</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1. <u>Stricture.</u><br>2. <u>Incontinence.</u><br>3. <u>Impotence.</u> |
| Investigations | <b>Plain X-ray</b><br><div>-ve</div> <div>Fracture pelvis</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                         |
| Treatment      | 1. If the patient is poly-traumatized (mainly in intra-pelvic type): ABCD + 2 <sup>ry</sup> survey + treatment of life threatening injuries<br>2. Treatment of shock (Ryle, IV lines, IV fluids or blood + analgesics).<br>3. Treatment of associated injuries if present<br>4. Catheterization should be avoided and the patient is instructed to avoid passing of urine. Supra-pubic percutaneous cystostomy for drainage until the urethra heals.<br>5. Later on, urethral dilatation. <ul style="list-style-type: none"> <li>Some surgeons advocate early open &amp; repair of the urethra with excision of the traumatized section.</li> <li>Other wait longer but may attempt to use a urethroscope to allow a urethral catheter to be placed while healing occurs</li> </ul> |                                                                         |

# Urinary tract inflammation

## A- Peri-nephric abscess

➔ A perinephric abscess is suppuration of perinephric fat & fascia.

### Etiology

- A perinephric abscess usually affects adults, more on the right side.
- It occurs in two forms :

#### 1. Primary perinephric abscess:

- Rare.
- The infection is blood borne from a distant septic focus, such as a boil or carbuncle.

#### 2. Secondary perinephric abscess:

- Is more frequent due to extension of infection from the kidney or a neighbouring structure, e.g. spine, pleura or pelvic organs.

### Pathology

- The infecting organisms are staphylococci, less commonly streptococci & E.coli.
- Pus collects between the kidney & perinephric fascia & may extend downwards into the pelvis along the course of the ureters, or may burst through the perinephric fascia to reach the loin.
- The abscess may be unilocular or multilocular.
- A neglected abscess may be complicated by septicemia & septic shock.

► **Etiology:** 1ry, 2ry

► **Org.:** Staph. mainly

► **C/P:** fever, pain, swelling, comp.

► **Invest.:** U/S, CT

► **TTT:** drainage, antibiotics





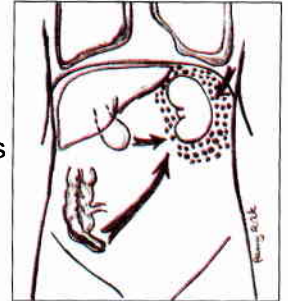
## Clinical features

### Symptoms

- **Loin pain** → Pain increases by movement, respiration & coughing.
- Hectic fever.

### Signs

- Fever
- Loin fullness, tenderness & rigidity.
- Swelling is ill-defined & doesn't move with respiration.
- Oedema & redness of skin may be present if the abscess extends superficially.
- Slight eversion & flexion of hip joint from spasm of psoas muscle.



### Investigations

1. Urine analysis is usually sterile.
2. Blood picture shows polymorphonuclear leucocytosis.
3. Ultrasound or CT scan is diagnostic (pus around kidney).
4. Plain X-ray may show scoliosis with the concavity towards the abscess side, together with obliteration of the psoas shadow & elevation & fixation of the diaphragm.

### D.D.

- Is similar to that of acute pyelonephritis.

### Treatment

1. As for any abscess in the body treatment is by **Drainage of pus.**
  - Adequate lumbar incision under general anaesthesia.
  - All pockets are thoroughly opened.
  - A wide drain inserted
2. Antibiotics.

## B- Pyonephrosis

### Definition

- Retention of infected urine and pus in the kidney due to obstructing agent.

### Etiology

(Obstruction & infection)

- **Organism:** E.coli.
- **Route of infection:** usually ascending infection.
- **Predisposing factors:** obstruction and ↓ immunity.

- ▶ **Org.:** E. coli mainly
- ▶ **Path.:** 1ry, 2ry
- ▶ **Etiology:** Closed (dangerous), open
- ▶ **Comp.:** G. (sepsis), L. (abscess)
- ▶ **Invest.:** CBC + urine C/S + U/S
- ▶ **TTT:** antibiotics + drainage

⇒ It may be:

1. **Primary pyonephrosis** → Infection then obstruction or occurs simultaneously.
2. **Secondary pyonephrosis** → Infection of pre-existing hydronephrosis  
(Obstruction occurs at first → hydronephrosis → followed by infection)

### Pathology

☑ **Pyonephrosis is usually unilateral.**

#### A. Primary pyonephrosis

- The kidney is not very much enlarged.
- Pelvis is inflamed → inner lining is irregular.
- Parenchyma of the kidney is extensively destroyed.

- Perinephritis → extensive adhesions around the kidney.
- 2<sup>ry</sup> Phosphate stone is common.

### B. Secondary pyonephrosis

- The kidney is hugely enlarged.
- The cavities are filled with thick pus.

### Clinical picture

#### A- Closed type (complete obstruction)

*(No pus comes out with urine due to the obstructing agent, toxemia is severe)*

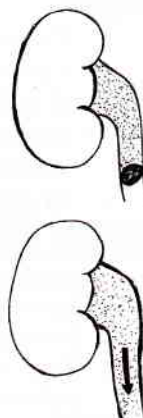
- **General:** hectic fever, rigors, anorexia, headache, malaise...etc.
- **Local:**
  1. Loin pain (throbbing) and tenderness (pus under tension).
  2. Renal swelling: usually small (large in 2<sup>ry</sup> pyonephrosis).

#### B- Open type (partial obstruction)

*(The pus comes out in large amount so toxemia is less severe)*

- Presents with triad of anemia, fever & renal swelling (large).
- With or without secondary cystitis (pyuria, frequency, burning micturation).

- Pyuria is absent if it is closed type.



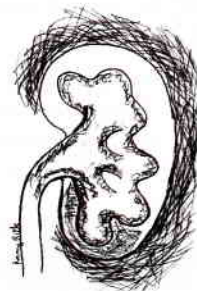
### Complications

#### General

- Septicemia and septic shock in closed type.
- Pyemia.

#### Local

- Permanent renal scarring.
- Peri-nephric abscess.
- Renal failure.



### DD

- |                               |                        |
|-------------------------------|------------------------|
| ▪ Basal pneumonia & pleurisy. | ▪ Acute pancreatitis.  |
| ▪ Acute cholecystitis.        | ▪ Perinephric abscess. |
| ▪ Acute appendicitis.         |                        |

### Investigations

#### For diagnosis:

- **CBC, ESR & CRP** → elevated TLC, high ESR & CRP.
- **Urine analysis, C&S:** pyuria in open type, no pyuria in closed type.
- **U/S:** dilatation of the renal pelvis and calyces ± renal damage.
- **IVU:** (if KFTs within normal) after resolution of the acute attack → poor renal function and hydronephrosis on the affected side.
- **Cystoscopy:**
  - 1- **In open type:** shows signs of chronic cystitis and purulent efflux from one ureteric orifice.
  - 2- **In closed type:** ureteric catheter may be arrested at the site of obstruction, or may enter the pelvis and gives exit to purulent urine with marked relief of pain.

#### For cause

- **Plain X-ray:** may show stone.

#### For complications

- **KFTs.**

## Treatment

### Treatment of pyonephrosis

#### 1- An obstructed infected kidney should be treated urgently:

- Antibiotics & kidney drainage by inserting a large percutaneous nephrostomy tube or ureteric catheter. Any cause of obstruction as a stone or stricture should be corrected.

#### 2- Open type:

- If the kidney is functioning: treatment of the cause.
- If the kidney is not functioning: preliminary nephrostomy is done.
- If the kidney still not functioning: nephrectomy is done provided that the other kidney is normal.

## C- Bilharziasis of UB

### Etiology

- Due to *Schistosoma hematobium* (96%) or *mansoni* (4%).

### Incidence

- Middle aged male
- (Male : Female = 3 : 1).

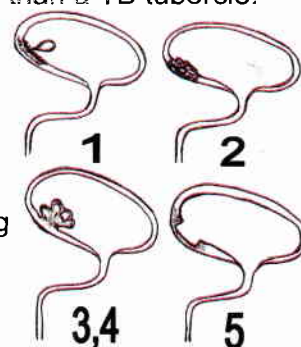
### Pathology

#### Site

- The lesions affect the mucosa, muscle layer or peri-vesical tissue.

#### Macroscopically (cystoscopy) (Depending on duration, one or more can be seen)

- Bilharzial pseudo-tubercle:** (earliest specific appearance of the disease)
  - Bilharzial ova → inflammation of mucosa → granulation tissue → pseudo-tubercle.
  - They are larger, more numerous, prominent and yellowish than a TB tubercle.
- Bilharzial nodule:** caused by fusion of pseudo-tubercles.
- Granuloma formation:** aggregation of nodules → masses.
- Bilharzial papilloma:** pedunculated masses.
- Ulceration (bilharzial ulcers):**
  - Sloughing of mucous membrane over the dead ova.
  - Sloughing of nodules, granuloma and papilloma.
- Sandy patches:** calcified dead ova + degenerated overlying epithelium (more around ureteric orifices).
- Fibrosis:** resulting from 2<sup>nd</sup> infection → contracted bladder.



#### Microscopically

- Cystitis glandularis, cystitis cystica, leucoplakia → predispose to UB carcinoma.

### Clinical picture

- Swimmer's or bather's itch due to penetration of cercaria through the skin may be followed 4- 12 weeks later by fever, urticaria & asthma.
- Such symptoms usually pass unnoticed until ova invade the bladder within 6 months after cercarial penetration.

### Symptoms

#### 1- Hematuria:

- Is the cardinal symptom.
- It is usually slight (few drops), & terminal.

**2- Pain:**

- Some urethral burning may be felt, but with the occurrence of ulceration, stone formation & malignancy.
- The pain is markedly increased.

**3- Frequency:**

- From congestion of trigone but later on severe frequency follows secondary cystitis & other complications.

**4- Difficulty in micturition:**

- At first there may be a slight difficulty in voiding, together with a feeling of discomfort & heaviness in the perineum at the end of the act.
- In late cases, severe difficulty may occur from bladder neck obstruction.

**Signs**

- No signs are elicited until complications occur.

**Investigations****For diagnosis**➤ **Urine analysis:**

- Last few milliliters of early morning urine are taken for several consecutive days.
- Bilharzial ova, RBCs, pus cells. Urine is usually alkaline (infected).
- Negative results don't exclude bilharziasis.

➤ **Cystography:** to study the shape and the size of the bladder.➤ **Cystoscopy:** to study the macroscopic pathology in the bladder wall + biopsy.➤ **Antibody detection by ELISA.****For complications**➤ **Plain x-ray & IVU:** shows bladder calcification and calcified lower ureter.**Treatment****Medical treatment**

- Praziquantel single dose 60mg/kg (max. 400mg) + urinary antiseptics (Antimony).

**Surgical treatment**

- **Polyps:** cystoscopic removal + biopsy.
- **BNO:** wedge excision to relieve urine outflow obstruction.
- **Ulcer:** cystoscopic cauterization.

## D- Lower UTI & Cystitis

**Etiology****Causative organism**

- **Non-specific** → E-coli, Proteus, Staph. Epidermis, Strept. Faecalis.
- **Specific** → TB, Bilharziasis.

**Route of infection**▪ **Direct:**

- Ascending from urethra (most common).
- Descending from kidneys.
- From nearby structures e.g. fallopian tubes, vagina or GIT (uncommon).

▪ **Blood, lymphatic.****Precipitating factors**

1. Incomplete emptying of the bladder.
2. Presence of a calculus, foreign body or neoplasm.



3. Incomplete emptying of the upper tract caused by dilatation of the ureters associated with pregnancy or vesico-ureteric reflux.
4. Estrogen deficiency which may give rise to lowered local resistance.
5. Colonization of the perineal skin by strains of *E. coli*.

### Clinical picture

#### General

- FAHM

#### Local

- Pain (mild to severe).
- Frequency (during day and night).
- Hematuria and pyuria (usually present).

### Investigation

- **Urine analysis and culture/sensitivity:** a midstream specimen is preferred.
- **Others:**
  - IVU & cystoscopy.
  - Measurement of urinary flow rates and post-void residual urine.
  - Difficult cases may require urodynamic investigation.

### Treatment

- 3- Rest.
- 4- Ample of fluids.
- 5- **Antibiotics:** trimethoprim, amoxicillin or quinolones (or according to culture/sensitivity).  
⇒ **Failure to respond indicates the necessity for further investigation to exclude predisposing factors**

## Urinary stones

### Incidence

- Common disease present in 10 - 20% of population.
- Males > females (the ratio in renal stones is 4:3 and 8:1 in bladder stones).
- Middle age (30 – 50) but no age is immune.
- The disease is common in Egypt due to bilharziasis and hot climate.

- ▶ 10% - 20%
- ▶ Middle aged ♂
- ▶  $\text{Ca}^{++}$  stones mainly (75%)
- ▶ **Etiology:** metabolic, infective
- ▶ **Path.:** Spiky, 2ry, v. hard, lucent
- ▶ **C/P:** asymptomatic, pain
- ▶ **Comp.:** HIMOM
- ▶ **CT scan**
- ▶ **TTT:** Conservative, active

### Types

1. Calcium stones (oxalate and phosphate) → 75%.
2. Phosphate stones → 15%.
3. Urate stones → 7 – 9%.
4. Cystine stones → 1 – 3%.
5. Xanthine → very rare.

### Predisposing factors

#### 1. Metabolic errors (1<sup>ry</sup> stone)

- a- **Calcium stones:** (mainly  $\text{Ca}^{+2}$  oxalate and  $\text{Ca}^{+2}$  phosphate):
  - Idiopathic hypercalcuria.
  - Hyperparathyroidism.
  - Bone metastasis.
  - Immobilization → skeletal decalcification → increase in urinary calcium.



- ↓ Urinary citrate e.g. during menses (its presence keeps insoluble  $\text{Ca}^{+2}$  phosphate).
- Loss of terminal ileum (by resection or Crohn's disease) → ↑ oxalate.
- Sarcoidosis.
- Vitamin D intoxication.
- Hard water.
- Subcutaneous fat necrosis.

**b- Uric acid stones:**

- Gout.

- Giant tumor lysis syndrome.

**c- Cystine stones:**

- In cystinuria (inborn error of metabolism).

## 2. Infection (2<sup>ry</sup> stone)

- Infection leads to stone formation (usually phosphate stones) through:
  - Changing pH of the urine → alkaline urine.
  - Providing a nidus (pus cells + epithelial debris) for stone formation.

## 3. Others

**a- Diet:**

- Dehydration → increased concentration of urinary solutes → precipitate.
- Deficiency of vitamin A causes desquamation of epithelium → nidus.
- Milk and its products → calcium stones.
- Mango, tomatoes, berries, spinach → oxalate stones.
- Liver, kidneys, ducks → urate stones.
- Eggs, meat, fish (high sulphur containing proteins) → cystine stones.

**b- Hot climate:** hot weather → sweating → concentrated urine → stone.

**c- Randall's plaque:** erosion at the tip of a renal papilla → deposition of calcium on this erosion → called Randall's plaque.

**d- Primary renal disease:** e.g. congenital anomalies of urinary tract predispose to stasis, infection & stone formation.

## Pathology (Types of stones)

| Types                             | Oxalate         | Cystine         | Phosphate       | Urate           |
|-----------------------------------|-----------------|-----------------|-----------------|-----------------|
| Surface                           | Spiky           | Smooth          | Smooth          | Smooth          |
| Consistency                       | Hard            | Very hard       | Hard            | Hard            |
| 1 <sup>ry</sup> , 2 <sup>ry</sup> | 1 <sup>ry</sup> | 1 <sup>ry</sup> | 2 <sup>ry</sup> | 1 <sup>ry</sup> |
| Radiological                      | Opaque          | Opaque          | Opaque          | Lucent          |
| Color                             | Brownish        | Pink to yellow  | Dirty white     | Reddish brown   |



Jagged stone



Smooth stone



Staghorn stone



Smooth stone

- Oxalate stone: spiky → injury → blood → brownish in color & early C/P.
- Phosphate stone:
  - Is formed of ammonium, magnesium & calcium salts i.e. triple phosphate (**struvite**) & is usually due to proteus infection.
  - It causes minimal symptoms so it is discovered as stag horn stone (i.e. takes the shape of the calyces).
  - The surface is laminated, every layer = an attack of infection.
- Cystine stone: opaque due to sulphur content.
- Xanthine calculi: are smooth, rounded, brick red in color and show lamellation on cross section.

**Clinical picture**

1. **Usually asymptomatic (accidentally discovered):**  
if bilateral, uremia may be the first presentation.

2. **Pain (the leading symptom in 75%):**

⇒ **Renal stones:**

- Dull aching pain due to stretch of renal capsule.
- Site → in the flanks.
- Associated with nausea and vomiting.
- O/E → tender renal swelling.

⇒ **Ureteric stones (ureteric colic):**

- Severe **agonizing** pain.
- Site: in the **loin** radiating to **groin** (and to the tip of penis if at the intramural ureter).
- Sudden onset, short duration (**rarely > 8 hours**).
- Associated with nausea, vomiting and if intramural → strangury (painful passage of few drops of urine).
- Hematuria may occur after attack of ureteric colic.
- O/E → rigidity of lateral abdominal muscles (not rectus abdominis muscle).

⇒ **Bladder stones:**

- Varies from slight discomfort to severe pain.
- Site: in the supra-pubic region referred to the tip of penis or vulva at the end of micturation (due to contraction of the bladder around the stone).
- Timing: more during day, aggravated by movement and relieved by lying down.
- Associated with:
  - **Frequency (earliest)**: first diurnal then diurnal and nocturnal (after infection).
  - **Difficulty in micturation**: strangury with few drops of blood stained urine and sense of incomplete evacuation.
- O/E → supra-pubic tenderness (and if huge stone → felt by bimanual examination).

⇒ **Urethral stones:**

- **Migratory stone**: history of renal colic 2-3 days before.
- During the last micturation → sudden arrest of urine.
- Followed by acute retention.
- O/E → felt on the under surface of penis if in penile urethra.

3. **Clinical picture of complications:**

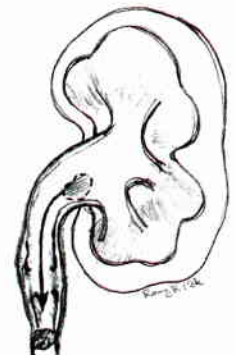
- ⇒ **Uremia**: anorexia, hiccough, asterixis, anemia, bleeding tendency, confusion, coma and pericarditis.
- ⇒ **Painful hematuria or pyuria (if infected).**
- ⇒ **Anuria**: due to retention.
- ⇒ **Severe persistent renal pain**: if complete obstruction of ureter.

**Complications (HIMOM)****Hematuria (painful)***Due to ulceration:*

- Total** → in renal, pelvic or ureteric stones.
- Terminal** → in bladder stones.
- Initial** → in prostatic urethral causes.
- Not related to micturation** → in distal urethral causes.

**Clinical picture:**

- 1- Asymptomatic.
- 2- Pain.
- 3- Complications (hematuria)



**Infection**

- **Pyelonephritis** → loin pain, fever, rigors, frequency and dysuria.
- **Pyonephrosis** → painful loin swelling with marked constitutional symptoms.
- **Cystitis** → supra-pubic pain with day and night frequency & dysuria.

**Migration**

- Leading to change in the character of pain according to the site.

**Obstruction**

⇒ **Back pressure:**

**A- Above the urinary bladder:**

1. **Partial** → ipsilateral hydroureter and hydronephrosis:
  - Usually discovered by investigations to the 1<sup>st</sup> cause.
  - Rarely presented by loin swelling or pyonephrosis if infected.
  - Bilateral cases → renal atrophy & renal failure.
2. **Complete** → calculi anuria:
  - If bilateral ureteric obstruction or unilateral in the only functioning kidney.
  - No urine, no desire, empty bladder.

**B- At bladder neck or urethra** → acute retention

- Painful desire with full bladder.

**Malignancy**

- Squamous cell carcinoma on top of leucoplakia.
- Exaggeration of vesical syndrome with strangury and supra-pubic mass.

DD

**Causes of loin to groin pain**

1. **Renal or ureteric calculi.**
2. **Infection:**
  - Pyelonephritis.
  - Cystitis with ascending infection.
3. **Hydronephrosis.**
4. **Renal cell carcinoma.**
5. **Carbuncle of the kidney.**

*The principal difficulty on the right side is to distinguish symptoms and signs of ureteric colic from those of acute appendicitis or acute cholecystitis. In practice, the patient with acute renal colic is usually in greater pain and less systemically ill.*

**Investigations****A- For diagnosis****A. Laboratory:**

⇒ **Urine examination:**

- RBCs are detected in 90% of specimens.
- Crystals:
  - Envelope-like → oxalate stone.
  - Hexagonal plate → cystine stone.

**B. Radiology:**

1. **Plain x-ray (KUB film):** (shows 90% of urinary stones)

- Postero-anterior view and lateral view.
- In lateral view, if calcification is anterior to the vertebral body = outside the urinary tract) (☆).

(☆) **Opacities on a plain abdominal x-ray which may be confused with renal calculi:**

1. Calcified mesenteric LNs.
2. Gall stones.
3. Phlebolith, faecolith, appendicolith.
4. Ossified tip of 12<sup>th</sup> rib.
5. Calcified T.B lesion of the kidney.
6. Foreign body in the alimentary canal.
7. Calcified adrenal gland.
8. Fracture tip of transverse process of lumbar vertebra.

**2. U/S (very commonly used):**

- The presence of stones either radio-opaque or radiolucent.
- Renal parenchymal thickness.
- Not reliable in visualization of uretric calculi.

**3. CT scan with contrast (preferably spiral CT):** are now the mainstay of imaging.

**4. IVU: (intravenous urography = descending urography)**

- Done if KFTs are within normal.
- **Anatomical values:**
  - To detect radio-lucent stones (10%) → filling defect.
  - To show any back pressure.

▪ **Functional values:**

- Differential kidney function.

▪ **Contraindications:**

- Blood urea > 50 mg%.
- During attacks of pain.

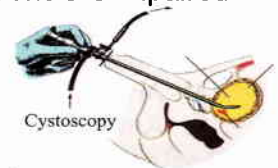
**5. Ascending urography (retrograde urography):** if renal functions are impaired.

**6. Isotope scanning of the kidney (rarely needed):**

- **Static (DSMA).**
- **Dynamic (DTPA).**

**C. Instrumental:** (Cystoscopy)

- May show bladder stones.
- May show bloody efflux from the ureteric orifice on the affected side or an impacted stone.



**Sites of impaction of ureteric stone**

- Pelvi-ureteric junction.
- Site of crossing of iliac arteries.
- At the site of crossing of the broad ligament in females or at the site of crossing of the vas in males.
- At the site of entry into the bladder wall.
- At the ureteric orifice.



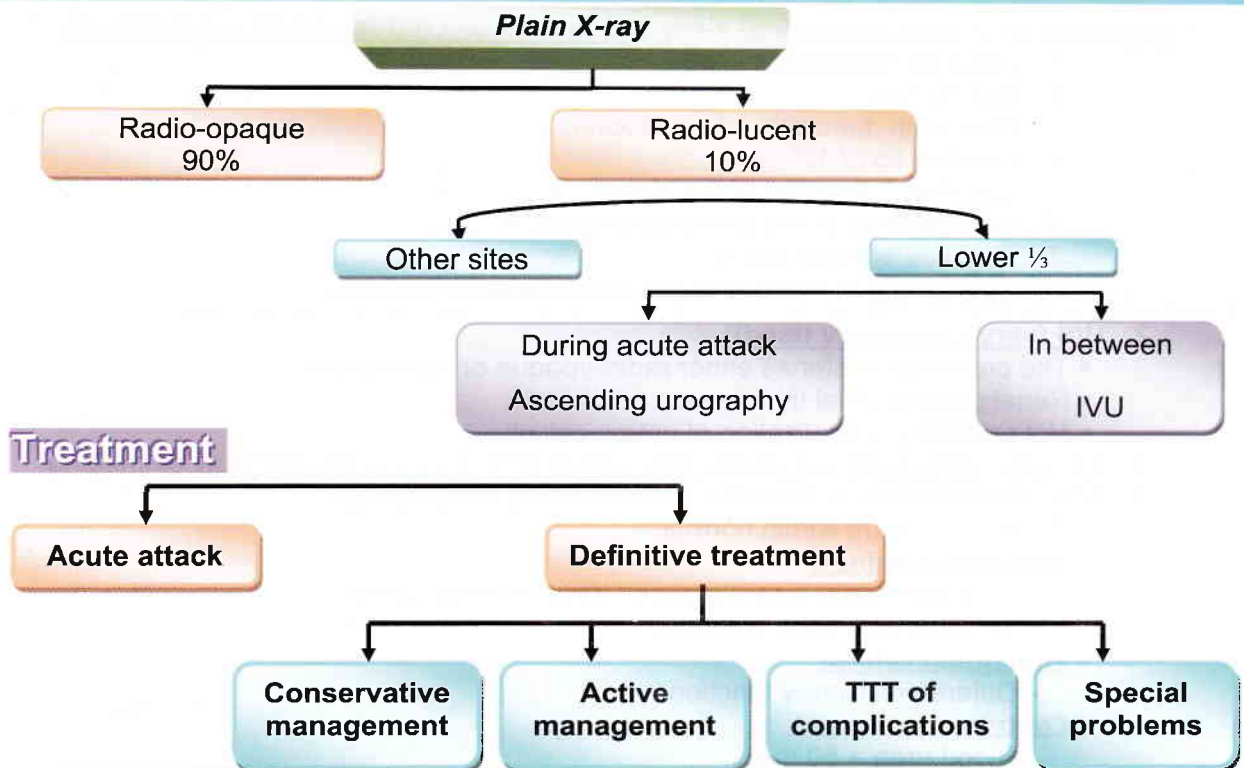
**B- For the cause (mainly in recurrent and bilateral cases)**

1. Serum calcium, phosphorus & parathormone → for hyperparathyroidism.
2. Stone analysis: if the stone is retrieved.
3. Uric acid in blood.
4. Calcium, uric acid, cystine in 24hours urine.

**C- For complications**

1. Urine analysis: RBCs, pus cells, culture & sensitivity.
2. KFTs: BUN and creatinine.





### I- Acute attack

1. Admission to hospital.
2. Analgesics (morphine or nowadays NSAIDs e.g. Declofenac, Endomethacin).
3. Antispasmodics (controversy).
4. Antibiotics for prophylaxis.
5. Ample of fluids.

### II- Definitive treatment

(After resolution of the acute attack or in accidentally discovered stones)

#### 1. Conservative management (up to 2 weeks):

(If small < 0.5 cm, with no complications → 90% will pass spontaneously)

⇒ Amples of fluids, Antispasmodics, Acidification of the urine, Antibiotics & follow up.

#### 2. Active management (if failed conservative, complicated or > 0.5cm):

⇒ Renal stone:

##### A. Instrumental:

- If 1-2 cm → Extra-corporeal Shock Wave Lithotripsy (ESWL).
- If > 2 cm (or stag-horn) → Percutaneous nephrolithotripsy (PCNL) ± ESWL.

##### B. Surgical (if failed or unavailable instrument):

- Renal stone → Nephro-lithotomy.
- Pelvic stone → Pyelo-lithotomy.
- Stag horn stone → Extended pyelo-nephro-lithotomy.

- Partial nephrectomy → if multiple stones causing cavitations in the lower calyx.
- Total nephrectomy → if the kidney is non-functioning and the other kidney is normal.



⇒ **Ureteric stone:****A. Instrumental:**

- Upper  $\frac{1}{3}$  ureter → push-bang technique or ESWL in situ.
- Middle  $\frac{1}{3}$  ureter → push-bang technique (1<sup>st</sup> line) or ESWL in situ if detected by U/S (difficult).
- Lower  $\frac{1}{3}$  ureter → Dormia basket or J-J stent (double-J stent).

**B. Surgical (if failed or unavailable instrument):**

- Upper  $\frac{1}{3}$  ureter → Pyelo-lithotomy through lumbar or Morris incision.
- Middle  $\frac{1}{3}$  ureter → uretero-lithotomy through Abernathy's incision.
- Lower  $\frac{1}{3}$  ureter → ureterolithotomy, lower midline or Pfannenstiel's incision.

⇒ **Bladder stone:****A. Instrumental:**

- If 1 – 2 cm → Cystoscopic litholapaxy.
- If failed or contraindicated → percutaneous supra-pubic litholapaxy.

**B. Surgical:**

- If > 2 cm → Supra-pubic cysto-lithotomy.

⇒ **Urethral stone:**• **Prostatic urethra:**

- Push to bladder to be crushed by litholapaxy & evacuate fragments.
- If failed → Supra-pubic cysto-lithotomy.

• **Penile urethra:**

- Local anesthetic gel & try forceps extraction by urethroscope.
- If impacted → Urethrotomy + supra-pubic cystostomy.

**3. TTT of complications:**⇒ **If UTI** → preoperative antibiotics.⇒ **Hydronephrosis:**• **If the kidneys are still functioning** → removal of the stone.• **If the kidneys are not functioning:**

- If unilateral & the other kidney is functioning → nephrectomy.
- If bilateral → nephrostomy tube, then treatment of the better functioning kidney; if still not functioning → dialysis then transplantation.

⇒ **Pyonephrosis:** as before but add parenteral antibiotics.⇒ **Acute retention of urine:** relief of retention by catheterization or supra-pubic cystostomy, to be prepared for definitive treatment.⇒ **Calculus anuria:**

- Relieve by ureteric catheter with trial of endoscopic extraction.
- If failed → nephrostomy tube then uretero-lithotomy.

**4. Special problems:**⇒ **Recurrence:** avoided by:

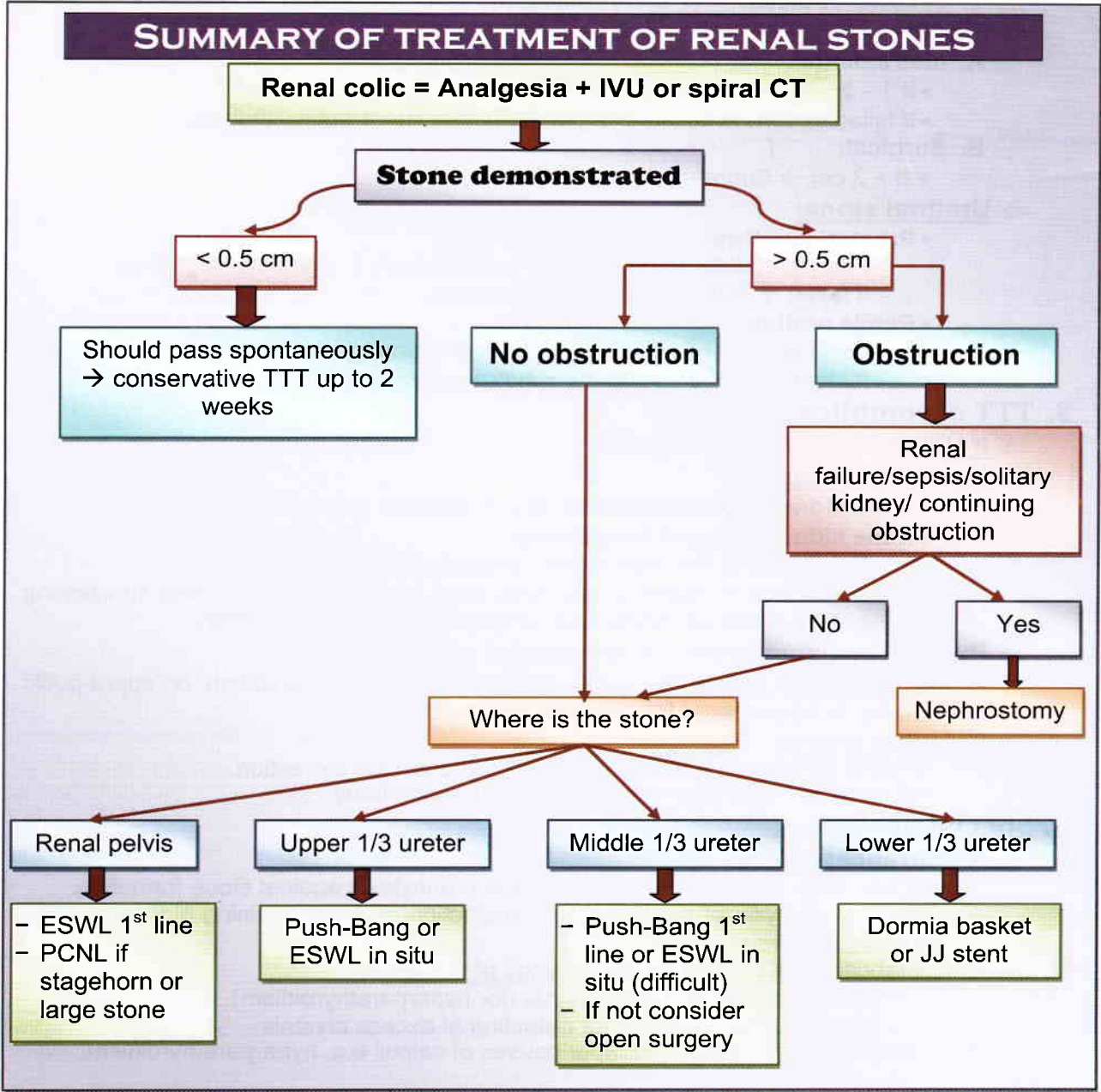
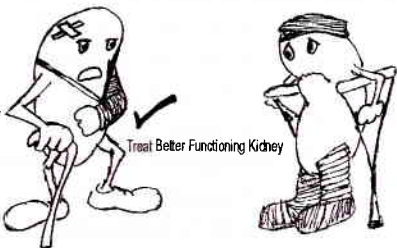
1. Excess water intake is the most valuable prophylaxis against stone formation.
2. Chemical analysis of the stone, and restriction of diet containing high amount of its composition.
3. **Metabolic work-up to know the etiology of stone:**
  - Serum calcium and phosphorus (for hyperparathyroidism).
  - 24-hour urine collection for detection of excess crystals.
4. Treatment of infections and other causes of calculi e.g. hyperparathyroidism.

5. Follow up of patients that had previous stones to detect early recurrence.

⇒ **Bilateral stones:** start by the better functioning kidney then treat the other one after 2 - 3 months with exception:

- 1. Painful side first if pain persists.
- 2. Pyonephrosis first to save life.

⇒ **Multiple stones:** start by urethra, ureter, kidney then bladder



## More details about treatment of stones

### 1. Conservative:

#### ▪ **Indications:**

1. Small (less than 0.5 cm), with no complications.
2. Patient is unfit for surgery.
3. Prophylaxis against recurrence of stones after instrumental or surgical treatment.

#### ▪ **Methods:**

1. **Avoid foods** which cause crystalluria, e.g.
  - i. Oxalate in spinach, tomato, berries.
  - ii. Uric acid in liver, brain, kidney, ducks, goose & red meat.
  - iii. Cystine in high sulphur containing proteins e.g. eggs, meat and fish.
2. **Ample amount of fluids** or diuretics; the best is osmotic diuresis.
3. **Antibiotics** e.g. sulfa, quinolones.
4. **Acidify** the urine by ammonium chloride or vitamin C in phosphate stone.
5. **Analgesic & antispasmodic** during the attack of colic.
6. **Agenda: Follow up by radiography** every 6-8 weeks & if no detectable descent is noted, the stone should be removed by instrumental or surgical treatment.

### 2. Instrumental:

#### ▪ **Indications:**

1. Stone larger than 1 cm.
2. Complications.
3. Stone not moving (ureteric stones).

#### ▪ **Methods:**

##### 1. **Extracorporeal Shock Wave Lithotripsy (ESWL)**

(Indicated in all radio-opaque stones less than 2 cm)

#### ⇒ **Methods:**

##### A. **Ultrasonic lithotripsy:**

- Explosion of the stone using ultrasonic waves.
- The micro-fragments will pass spontaneously in the urine.

##### B. **Electro-hydraulic lithotripsy:**

- Explosion of the stone by shock waves, directly at the calculus.
- Micro-fragments will pass spontaneously in the urine.

#### ⇒ **Contraindications:**

##### A. **Urological:**

1. Distal obstruction.
2. Large stones except after decreasing the size of the stone by PCNL.
3. Renal insufficiency.
4. Single kidney.
5. Acute pyelonephritis.

##### B. **Non-urolological:**

1. Pregnancy and bleeding tendency.
2. Spine abnormalities (as location of the stone is difficult).



⇒ **Complications:**

1. Infection: the principle complication as the stones contain bacteria → released when the stone is broken (**give prophylactic antibiotics**).
2. Transient attacks of hematuria.
3. Ureteric colic during the passage of fragments (**give analgesics**).
4. Failure to disintegrate the stone.
5. Acute obstruction by fragments (**put self-retaining ureteric catheter**).

**2. Percutaneous nephrolithotomy**⇒ **Indications:**

1. Stone > 2 cm (especially hard cystine stone).
2. ESWL failure.

⇒ **Method:**

1. Establish a track for percutaneous endoscopy.
2. A nephroscope is introduced at the location of the stone.
3. Small stone → extracted with forceps.
4. Large stone → fragmented by lithotripsy.
5. Insertion of a nephrostomy tube for 48 hours for drainage.

⇒ **Advantages:**

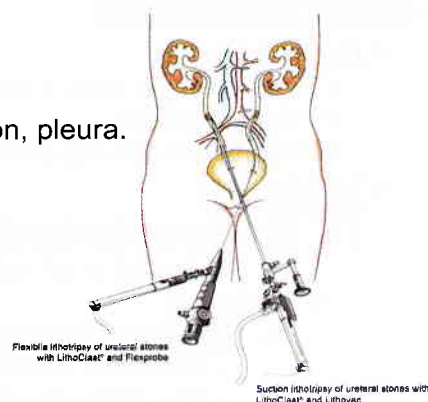
1. No incision.
2. Short hospital stay.
3. Can be done by local anesthesia.

⇒ **Complications:**

1. Hemorrhage.
2. Residual stones.
3. Injury:
  - Renal or other organs injury e.g. colon, pleura.
  - Bleeding ± urine extravasations.
  - A-V fistula formation.
  - Subcutaneous fistula.

⇒ **Contraindications:**

1. Bleeding tendency.
2. Congenital renal anomalies.
3. Pregnancy and spine deformities.

**3. Litholapaxy by lithotrite**⇒ **Method:**

1. Distending the bladder with boric acid solution.
2. Crushing the stone by lithotrite.
3. Evacuation of the gravels by Biglow's evacuator, Ellik evacuator.

⇒ **Contraindications:**

- i. Urethra: urethritis, stricture, SEP.
- ii. Bladder: contracted bladder, dilated bladder.
- iii. Stone: too large, too small, too hard or too soft.
- iv. Patient: below 10 years (small urethra).

**3. Surgical:**▪ **Indications:**

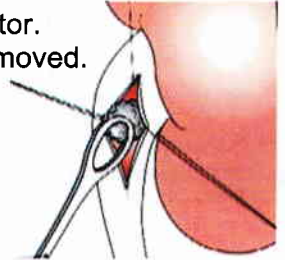
1. Failure of instrumental treatment.
2. Instrumental treatment not available.

▪ **Methods:** according to the site of the stone.

## Renal stone

### 1- Pyelo-lithotomy

- Always tried first especially with extra-renal pelvis.
- It can to be done in intra-renal pelvis by the use of Gil Vernet retractor.
- Incision in the posterior aspect of the renal pelvis → the stone is removed.
- Closure:
  - If no sepsis → interrupted absorbable suture.
  - If gross sepsis → leave a tube for drainage.



#### ⇒ Advantages:

- Minimal bleeding.
- No damage for renal parenchyma.
- Rapid healing.

### 2- Nephro-lithotomy

#### ⇒ Indications: (when pyelolithotomy cannot be done)

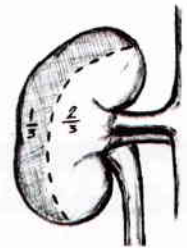
- Stone in a calyx with narrow neck.
- Intra-renal pelvis.
- Dense adhesions around the pelvis.

#### ⇒ Disadvantages:

- The reverse of advantages of pyelolithotomy.

#### ⇒ The incision is in the substance of the kidney, may be:

- In Brodel's line (in the posterior aspect of the kidney between lateral  $\frac{1}{3}$  & medial  $\frac{2}{3}$ ).
- Radial incision directly on the stone.



### 3- Pyelo-nephro-lithotomy

- Removal of the stone through an incision in the renal pelvis & the kidney substance.

#### ⇒ Indications:

- Multiple stones in the renal pelvis.
- Stag horn stone.

### 4- Partial nephrectomy

- If multiple stones causing cavitations in the lower calyx.

### 5- Total nephrectomy

- If the kidney is non-functioning provided that the other kidney is normal.

## Ureteric stone

### Stone in the upper $\frac{1}{3}$

- Can be removed by pyelolithotomy through Morris incision.

### Stone in the middle $\frac{1}{3}$

- Can be removed by ureterolithotomy through Abernathy incision.

### Stone in the lower $\frac{1}{3}$

- If above the ischial spine: removed by ureterolithotomy through Abernathy incision.
- If below the ischial spine: removed by ureterolithotomy through mid-line supra-pubic incision or Pfannenstiel incision.



**1- Morris (lumbar) incision:**

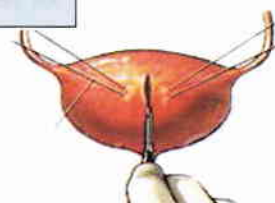
From above the renal angle to about 1" above the ASIS (passing downwards & forwards).

**2- Abernathy incision:**

1" above the ASIS and passes downwards & medially to mid-inguinal point (muscle cutting).

## Bladder stone

- Supra-pubic cysto-lithotomy.



## Prevention of Urinary Stones Recurrence

### General measures

1. Excess water intake.
2. The stone should be chemically analyzed.
3. Restriction of diet containing high crystals according to chemical composition of the stone.
4. Treating infection and other causes of stone formation.
5. Follow up of stone formers to detect early recurrence.
6. Metabolic work-up to know etiology of the stone.
  - Serum Ca and phosphorus to exclude hyperparathyroidism.
  - 24-hour urine collection for the following whose normal values are:
    - Ca <300 mg.
    - Uric acid <800 mg.
    - Oxalates <40 mg.
    - Citrates 300-900 mg.

### Calcium oxalate stones

1. Avoid diet rich in oxalates.
2. Hydrochlorothiazide 50 mg/d aids in the dissolution of Ca oxalate stones.
3. Citrates 5 mg bid inhibits crystallization of oxalates.

### Uric acid stones

1. Avoid diet rich in purines.
2. Rule out myeloproliferative or neoplastic diseases.
3. Urine should be kept alkaline, e.g. by  $\text{NaHCO}_3$  1 gm tds.
4. Allopurinol 30 mg/day is indicated in patients with hyperuricemia.

**Ammonium magnesium phosphate (struvite)**

1. Aluminum hydroxide orally restricts phosphate absorption.
2. Long term antibiotics to eradicate UTI.
3. Avoid indwelling catheters.
4. Increase urine acidity by oral administration of 1 gm vitamin C daily.

# Obstructive Uropathy

**Definition**

Obstruction anywhere in the urinary tract associated with changes in the urinary system proximal to the obstruction.

**Classifications**

1. Acute or chronic obstruction.
2. Partial or complete obstruction.
3. Unilateral or bilateral obstruction.
4. Congenital or acquired obstruction.
5. Extrinsic or intrinsic obstruction.

**Etiology****I. Unilateral****A. Kidney and pelvis:****• Congenital:**

1. Horse-shoe kidney.
2. Aberrant renal vessels crossing the pelvis.
3. PUJ obstruction.

**• Acquired:**

1. Stones.
2. Tumors of the kidney or pelvis.
3. Renal TB.

**B. Ureteric obstruction:****• From outside:**

1. Pressure from adjacent structures e.g. cancer cervix, rectum...etc.
2. Idiopathic retro-peritoneal fibrosis.
3. Retro-caval ureter.

**• In the wall:**

1. Congenital stenosis.
2. Ureterocele.
3. Inflammatory stricture after repair of damaged ureter, calculus or ureteric TB.
4. Neoplasm of ureter or bladder cancer involving the ureteric orifice.

**• In the lumen:**

1. Stone (commonest).
2. Clot retention.

- ☞ The commonest cause for unilateral obstruction is stone.
- ☞ The commonest cause for bilateral obstruction is BPH

## II. Bilateral (lower urinary tract obstruction)

- **Congenital:**

1. Posterior urethral valve (PUV).
2. Phimosis.

- **Acquired**

1. Benign prostatic hyperplasia (BPH) (commonest).
2. Cancer prostate.
3. Post-operative bladder neck scarring.
4. Urethral stricture (e.g. post-traumatic).

## Pathological changes

### A. Urethra

- Dilatation.

### B. Urinary bladder

- **Early** → Muscle hypertrophy and trabeculation  
→ Acquired false pulsion diverticulae.
- **Late** → bladder dilatation and atony → retention of urine.

### C. Ureter

- **Early** → muscle hypertrophy.
- **Late** → atony and dilatation (hydro-ureter).

### D. kidney

- **Morphological:**

- **Early** → pelvic hypertrophy.
- **Late** → pelvic atony and dilatation (hydronephrosis).  
→ Parenchymal thinning and atrophy.

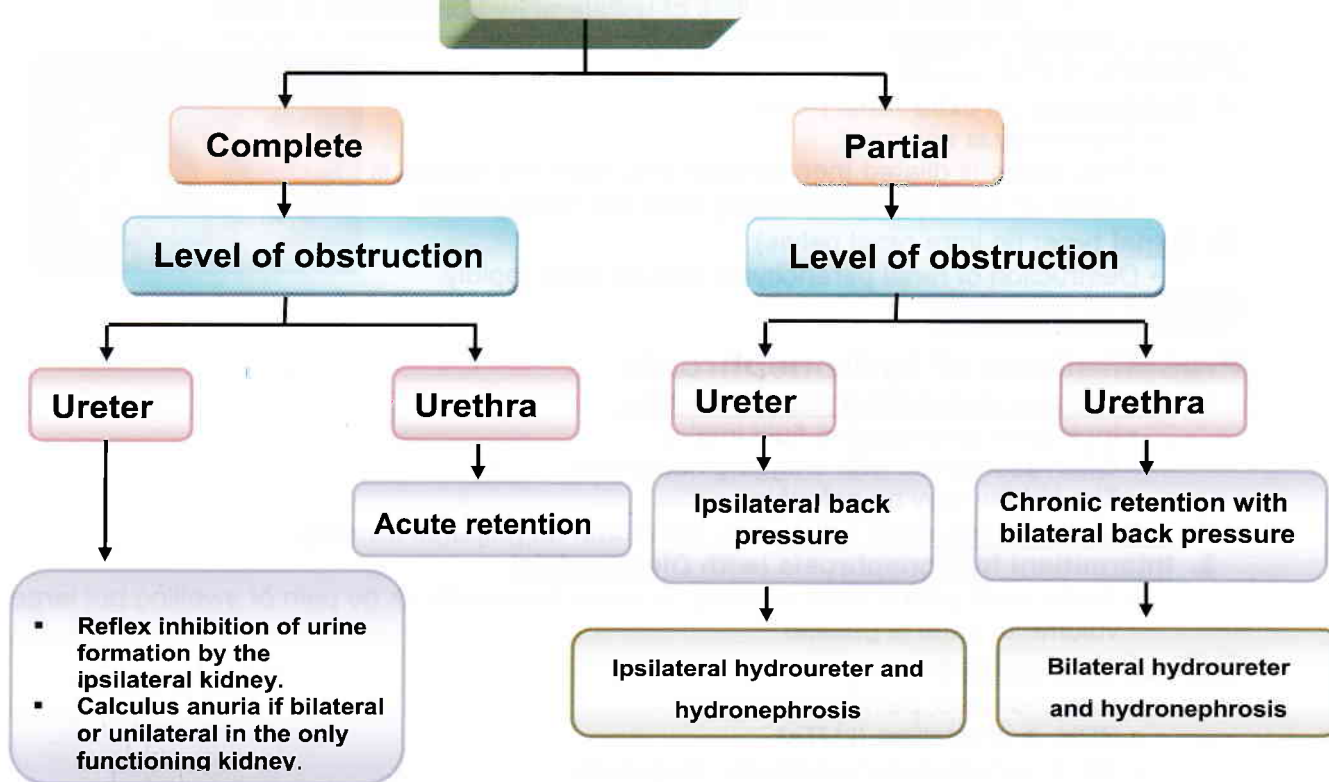
- **Functional:** Increased intra-pelvic pressure → urine excretion stops → ↓ GFR

- **If unilateral** → contralateral hypertrophy and ↑ function.
- **If bilateral** → renal failure.

## Sequelae of obstructive uropathy

- A. Hydronephrosis.
- B. Retention of urine.
- C. Calcular anuria.

## Obstruction



## A- Hydronephrosis

### Definition

**Aseptic** distention of the pelvi-calyceal system due to chronic or intermittent **obstruction**.

### Causes

- **Causes:** Cong., acquired
- **Path.:** Pelvic, renal
- **C/P:** Dietl's crisis, pain
- **Comp.:** as polycystic kidney
- **Invest.:** U/S, IVP
- **TTT:** TTT of the cause + nephrectomy

|            |                 | Congenital                                                                     | Acquired                                                               |
|------------|-----------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Unilateral | Renal           | Horse-shoe kidney, aberrant renal vessels crossing the pelvis, PUJ obstruction | Stones, tumors, renal TB, Bilharziasis, iatrogenic injury              |
|            | Ureteric        | Ureteric reflux, ureterocele, stenosis, retrocaval ureter                      | Stones, tumors, TB, pregnancy pressure from outside (as cancer cervix) |
| Bilateral  | Urinary bladder | Congenital contracture of the bladder neck                                     | Stones, BNO, tumors, T.B, neurogenic bladder                           |
|            | Prostatic       |                                                                                | Stones, BPH, cancer prostate                                           |
|            | Urethral        | Post. urethral valve, phimosis, meatal stenosis                                | Stones, urethral stricture                                             |

- The most common cause of bilateral hydronephrosis is SEP.
- The most common cause of unilateral hydronephrosis is stone.

### Pathology (2 types)

#### A. Pelvic type: (in extra-renal pelvis)

- The kidney is enlarged.
- First, pelvis is dilated then calyces and, later, the kidney is formed of loculi **communicating with the renal pelvis**.

#### B. Renal type: (in intra-renal pelvis)

- Destruction of renal parenchyma occurs more rapidly.



### Clinical picture

#### Presentations of hydronephrosis

##### 1. Mild pain or dull aching pain in the loin:

- Increases by excessive fluid intake.
- Often associated with dragging heaviness.
- The kidney may be palpable.

##### 2. Attacks of acute renal colic: may occur with no palpable swelling.

##### 3. Intermittent hydronephrosis (with Dietl's crisis)

- Acute renal pain + renal swelling → some hours later → no pain or swelling but large volume of urine is passed.

#### C/P of the cause

- Stone → colic, painful hematuria.
- BPH → prostatism (LUTs).
- TB → constitutional symptoms, frequency.

#### C/P of the complications

- e.g. Hypertension, fever (in infections) and in late cases → renal failure.

### Complications

#### General

- Renal hypertension.
- Renal failure (if bilateral hydronephrosis or unilateral in the only functioning kidney).

#### Local

⇒ As any cyst:

- a) Infection → pyonephrosis (2<sup>ry</sup>).
- b) Pressure atrophy.
- c) Others: calcification – rarely hemorrhage or rupture (more liable to trauma).

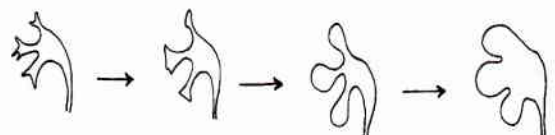
### DD

- Of loin mass (polycystic kidney, hypernephroma, liver swellings on the right side, splenomegaly on the left side).

### Investigations

#### For diagnosis

- U/S: detects the **size** of the kidney and the **thickness** of the renal cortex.
- IVU:
  - Dilatation of renal pelvis.
  - Flattening of calyces.





- Clubbing.
- Ballooning of the calyces, widening of the waist.
- Later, faint nephrogram around dilated calyces (**soap-bubble appearance**).

▪ **Ascending (retrograde) pyelography:**

- Indicated if IVU is contraindicated due to renal failure.
- It helps to visualize the pelvi-calyceal system → confirm site of obstruction.

▪ **Renal isotope scan:** to show the remaining functioning parenchyma.

▪ **Plain X-ray:**

- Abnormal psoas shadow.
- Stone, calcifications.

**For complications**

- **KFTs:** for renal failure.
- **Urine analysis:** polyuria of low specific gravity.
- **CBC & ESR:** to exclude infection.

**For the cause**

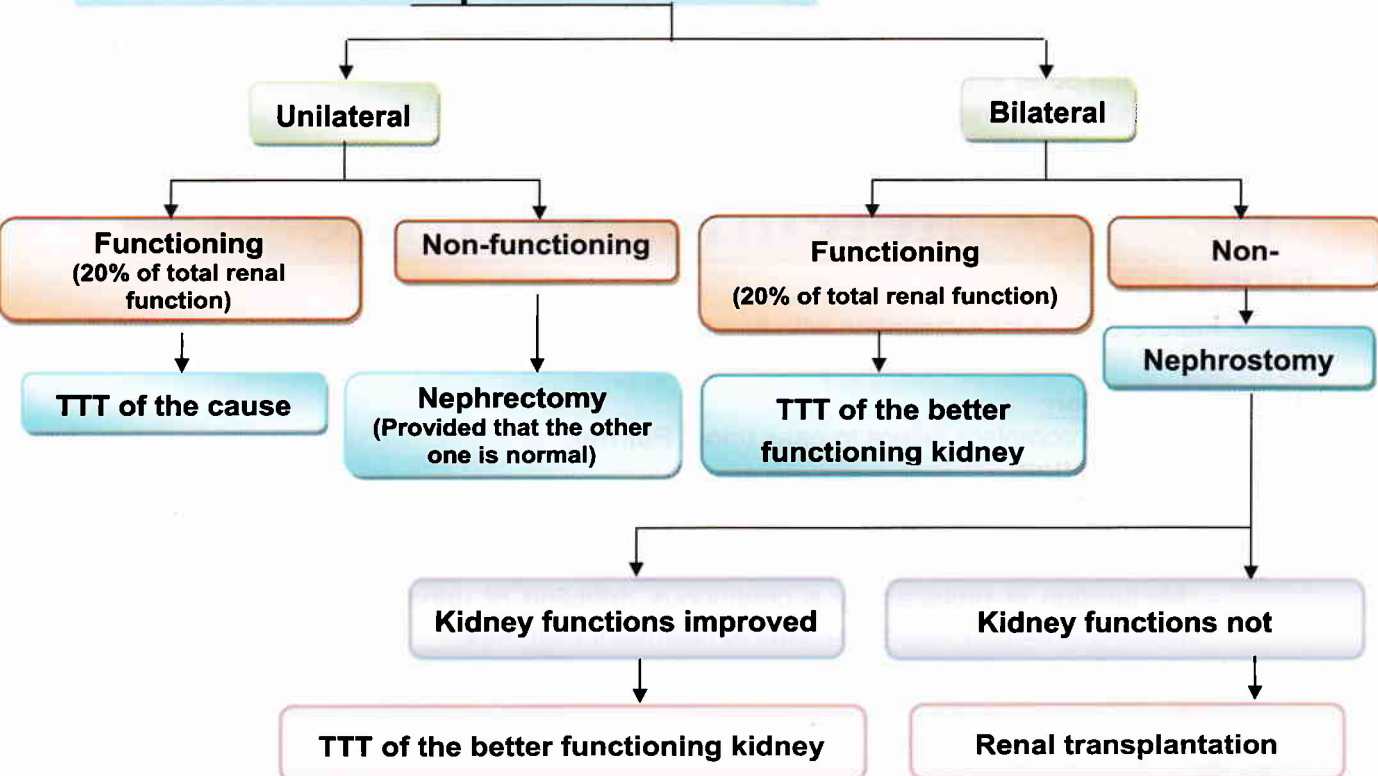
- **Trans-rectal U/S** → for SEP.
- **Cystoscopy** → bladder lesions (bilharziasis or tumor).

**Treatment**

**Indications of surgical treatment**

1. Bouts of renal pain.
2. Increasing hydronephrosis.
3. Evidence of parenchymal damage.
4. Infection.

**Plan of treatment depends on the case**



▪ **Acute obstructive conditions in urinary tract:**

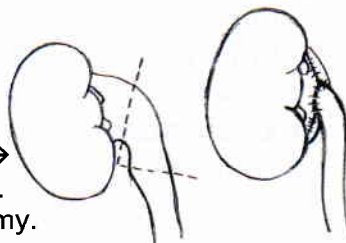
1. Acute retention of urine.
2. Calculus anuria.
3. Ligation of both ureters during surgical procedures.

- **Reconstruction of the dilated renal pelvis (Anderson-Hynes operation) is performed to reduce the size of the dilated pelvis.**
- **Recently:** endoscopic pyelolysis is done.

## Treatment of the cause

### 1- Congenital:

- a- Pelvi-ureteric lesions → Anderson Hynes principle.
- b- Ureterocele → diathermic fulguration.
- c- Bladder neck obstruction → trans-urethral resection.
- d- Posterior urethral valve → in-utero pig tail catheter → after delivery → transurethral resection by endoscope.
- e- Meatal stenosis (narrow external meatus) → meatotomy.
- f- Phimosis → circumcision.



### 2- Acquired

- a. Stone → endoscopic or surgical removal.
- b. SEP → trans-urethral resection of prostate (if small).  
→ Open prostatectomy (if large).

## Treatment of complications

- **Renal hypertension:** ACE inhibitors, nephrectomy of the affected kidney provided that the other kidney is normal.
- **Renal failure:** replacement therapy (dialysis or transplantation).
- **Pyonephrosis:** drainage and parenteral antibiotics.

# B- Retention of urine

## Definition

- Failure of bladder evacuation with functioning kidneys.

## Types

### 1. Acute retention:

- Sudden complete failure to pass urine, **Painful**.

### 2. Chronic retention:

- The patient can pass urine but some urine always remains in the bladder (residual urine increases), **Painless**.

### 3. Retention with overflow (false incontinence):

- Micturition is replaced by a continuous dribbling of urine from an over-distended bladder on top of neglected chronic retention, **Painless**.

# 1. Acute retention of urine

## Etiology

### 1. Mechanical lower urinary tract obstruction:

- **Urethra:** rupture, stones, blood clot, stricture.
- **Prostate:** SEP, acute prostatitis.
- **Bladder:** stone.
- **Pelvic mass:** incarcerated gravid uterus.
- **Fecal impaction.**

► **Symp.:** Pain, desire, inability

► **Invest.:** pelvic U/S

► **TTT:** conservative, catheterization

### 2. Paralytic:

- Acute stage of spinal cord injury.
- Multiple sclerosis.
- Surgical denervation of bladder.
- Spinal anesthesia.
- Drug induced: e.g. tranquilizers (e.g. TCA) or anticholinergics (e.g. propantheline).

### ► The most common causes are:

- Senile enlargement of prostate.
- Stone (in urethra).
- Trauma.
- Postoperative.

### 3. Hysterical.

### 4. Reflex: postoperative, especially after anorectal operations (due to anal pain e.g. post-hemorrhoidectomy).

## Clinical picture

## Symptoms

### 1. Symptoms of acute retention:

- Supra-pubic cramp like **pain**.
- Severe **desire** to micturate.
- **Inability** to pass urine in spite of desire.

### 2. Symptoms of the cause:

#### 1- Stone:

- UB → supra-pubic pain referred to the tip of penis & terminal hematuria.
- Urethra → urethral pain referred to the tip of penis & initial hematuria.

#### 2- SEP → prostatism (LUTs):

- Dysuria, night frequency, hesitancy, weak stream, post-micturation dribbling, double micturation and attacks of retention.

#### 3- History of trauma or operation few days before.

## Signs (locally)

### ▪ Urinary bladder:

- Bladder may be felt as a tender median pyriform swelling above the symphysis pubis → dull on percussion.

### ▪ Kidney: may be loin swelling due to back pressure.

### ▪ Urethra: palpate the urethra for stone

### ▪ DRE: may show the cause e.g.

- BPH → soft, symmetrical, smooth, preserved sulcus, mobile rectal mucosa.
- Cancer prostate → hard, asymmetrical, nodular, obliterated sulcus, fixed rectal mucosa.

## DD

- Acute retention from calculi anuria → (see calculi anuria).

## Investigations

### For diagnosis

- Diagnosed clinically.
- Pelvic U/S → shows full bladder.

### For the cause

- X-ray → stone, or carcinoma.
- Trans-rectal U/S → SEP, cancer prostate.

## Management

### Treatment of retention

#### A. Reflex retention → never rush to catheter.

- You are a doctor not a plumber → don't be catheter-minded.
- Neurological causes should be excluded by checking perianal sensations and LL reflexes.

#### ⇒ Conservative:

1. Strong analgesics for pain.
2. Encourage the patient to get out of bed.
3. Warm applications on the lower abdomen & perineum.
4. Running tap in front of the patient.
5. If the above measures failed → catheterization:

#### ⇒ Complications of catheterization:

1. Neurogenic shock.
2. False passage → hemorrhage & extravasations of urine.
3. Catheter fever, may be due to:
  - Urethritis.
  - Ascending cystitis or pyelonephritis.
  - Descending epididymo-orchitis.
  - Pyrogenic reaction.

#### B. Mechanical obstruction:

- Catheterization using *Nelaton's* catheter (removed after drainage of urine).
- **If recurrent retention** → Indwelling Foley's catheter & prepare patient for surgery.
- **If failed** → Supra-pubic catheter (Cystofix ®) under local anesthesia.

### Treatment of the cause

#### 1- Urethral stone:

##### a- Prostatic urethral stone:

- Push to bladder to be crushed by litholapaxy & evacuate fragments.
- If failed → supra-pubic cysto-lithotomy.

##### b- Penile urethral stone:

- Local anesthetic gel & try forceps extraction

#### 2- Urethral stricture:

- Dilate the stricture.
- Urethroscopy → divide stricture by urethrotome under vision → put urethral catheter.

#### Management:

- 1) Treatment of retention
  - a. Reflex
  - b. Mechanical
- 2) Treatment of the cause

**3- Bladder stone:**

- If < 2 cm → cystoscopic litholapaxy.
- If > 2 cm → cysto-lithotomy.

**4- BPH:**

- a- **Medical** treatment may be used if it's the 1<sup>st</sup> attack of retention:
  - 5-alpha reductase inhibitor (Proscar<sup>®</sup>)
  - α-blockers.
- b- **Surgical:**
  - Trans-Urethral Resection of Prostate (TURP).
  - Open surgery (trans-vesical or retro-pubic prostatectomy).

## 2. Chronic retention of urine

### Causes

- **Urethra:** stricture.
- **Prostate:** BPH, carcinoma.
- **Bladder:** BNO, carcinoma.
- **Pelvic mass:** fibroid, ovarian or cervical tumors.

### Clinical picture

#### Symptoms

- Supra-pubic discomfort.
- Painless urinary bladder swelling.
- First, frequency especially nocturnal then bed wetting later on.
- Symptoms of the cause (BPH) → see before.
- Symptoms of complications (hydronephrosis) → loin pain + swelling.

#### Signs

- Bladder is **full** (may reach to the level of umbilicus) & **not tender**.
- Signs of the cause (DRE → BPH, see above).
- Signs of complications (hydronephrosis → tender loin mass).

### Investigations

#### For diagnosis

- Like acute retention + urine analysis.

#### For the cause

- e.g. trans-rectal U/S → BPH.

#### For complications

- IVU to assess back pressure.

### Treatment

#### Treatment of chronic retention

- Foley's catheter or condom catheter.

**If urea >100 mg% → evacuate the bladder gradually:**

- To avoid reactive hyperemia of renal tissue → may cause hematuria or renal shutdown.
- Follow up to avoid post-obstructive diuresis which should be replaced by intravenous saline.

#### Treatment of the cause

- BPH (medical or surgical).
- Carcinomas → according to its stage.
- Urethral stricture → dilatation, internal urethrotomy or urethroplasty.

- ▶ PBH, malignancy
- ▶ **Symp.:** Swelling, discomfort + cause + comp.
- ▶ **Signs:** full bladder + cause + comp.
- ▶ **Invest.:** U/S + cause + comp.
- ▶ **TTT:** catheter + cause + comp.



### Treatment of complications

- Hydronephrosis.

## C- Calcular anuria

### Definitions

- **Anuria** → no urine excretion for 12 hours.
- **Oliguria** → urine excretion less than 300 ml in 24 hours.

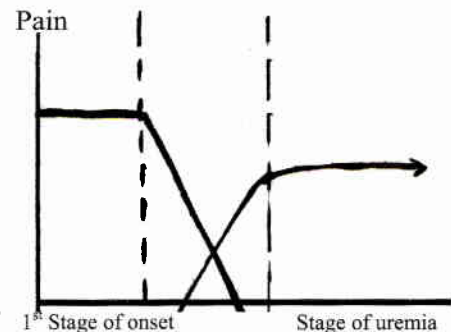
### Etiology

- **Bilateral complete ureteric obstruction by stones.**
- **Unilateral complete ureteric obstruction by stone if the other kidney is:**
  - Congenitally absent.
  - Surgically removed.
  - Pathologically destroyed.
  - Rare, reno-renal shut down.

- ▶ Unilateral mainly
- ▶ **C/P:** 3 stages (onset, tolerance, uremia)
- ▶ **Invest.:** Ascending pyelography, U/S
- ▶ **TTT:** ureteric catheter → uretroscopy → uretrolithotomy

### Clinical picture

- **There may be history of urinary stones.**
- **Stage of onset:**
  - Sudden onset of severe ureteric colic (describe).
  - Enlarged kidney on the affected side.
  - Tender renal angle.
  - No urine, no desire, empty bladder.
- **Stage of tolerance (3-8 days):**
  - Pain gradually disappears.
  - Blood urea progressively rises.
- **Stage of uremia:** After few days, uremia is established.



### DD

|                 | Calculus anuria                  | Acute retention of urine             |
|-----------------|----------------------------------|--------------------------------------|
| History         | ureteric colic                   | severe supra pubic pain              |
| Examination     | bladder is empty                 | bladder is distended                 |
| Catheterization | catheter is passed<br>→ no urine | catheter is passed<br>→ brings urine |

### Investigations

#### For diagnosis

1. **Plain x-ray:**
  - May detect radio-opaque stone.
2. **Ultrasonography:**
  - Is very important.
  - It reveals a distended pelvi-calyceal system on the affected side.
3. **Ascending pyelography:** diagnostic and therapeutic (see below).
4. **Cystoscopy:**
  - Impacted stone at the ureteric orifice.
  - Helps to pass ureteric catheters.
5. **Urethral catheter:** to exclude retention.

**IVU is contraindicated in anuria**

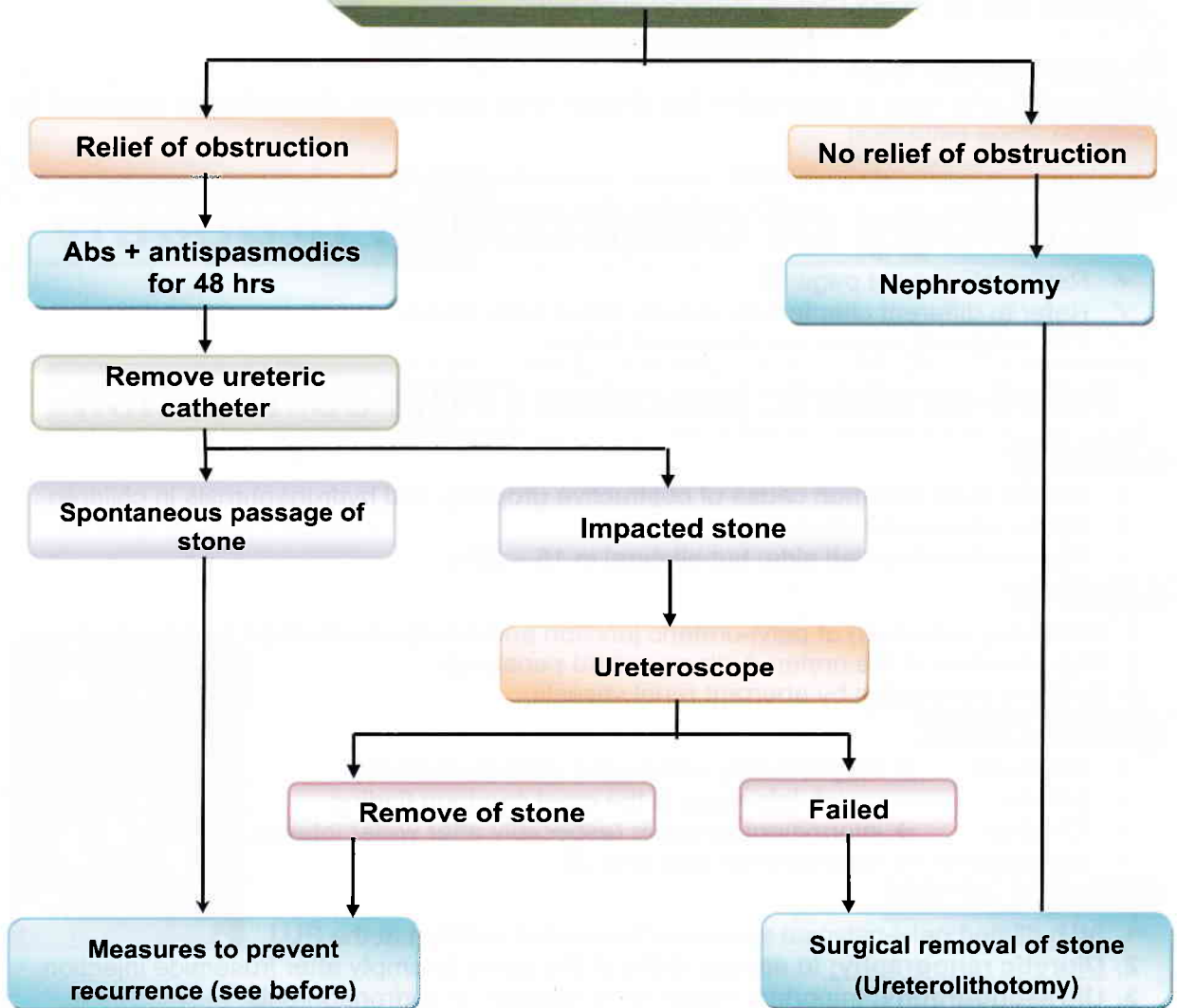
#### For complications

- Blood urea & electrolytes

**Treatment**

**It is a surgical emergency → urgent relief of obstruction**

Cystography + ascending pyelography  
(by ureteric catheter)

**Placement of bilateral ureteric catheters:**

- 1- **If obstruction relieved** → antibiotics and antispasmodics for 48 hours, then remove the ureteric catheters:
  - ⇒ If the stone passed spontaneously → measures to avoid recurrence (e.g. ample amounts of fluids, antibiotics).
  - ⇒ If the stone is impacted → ureteroscopy and removal of stone:
    - If removed → measures to avoid recurrence.
    - If failed → surgical removal of the stone (ureterolithotomy).
- 2- **If obstruction is not relieved** → nephrostomy, then removal of the stone surgically (ureterolithotomy) later on.

**Cystoscopy**

- Cystoscope is passed and bilateral ureteric catheters are passed beyond the stones.
- If they were inserted properly, a large amount of urine is drained.
- The catheters should be left in situ, until the general condition is improved and the stone is removed later on by the ureteroscope or surgically.

**Percutaneous nephrostomy tube**

- If ureteric catheter failed.
- U/S guided (the tube is inserted in the dilated renal pelvis) and the patient is prepared for surgical stone extraction.

## Etiology of obstructive uropathy

- ✓ Revise etiology at page 52.
- ✓ Refer to different chapters for details about each cause.
- ✓ The remaining causes are discussed below.

### Pelvi-ureteric junction (PUJ) obstruction

**Etiology**

- It is the most common cause of obstructive uropathy and hydronephrosis in children.
- More common in males.
- More common on left side, but bilateral in 15 – 20%.

**Etiology**

1. Narrowing (stenosis) of pelvi-ureteric junction and failure of relaxation (unknown cause).
2. High insertion of the ureter → disorganized peristalsis.
3. Extrinsic obstruction by aberrant renal vessels.

**Presentation**

- Antenatal → diagnosed by ultrasound (enlarged kidney).
- Infants → loin mass is the most common finding.
- Children → intermittent loin pain (especially after water intake).
- Adolescents → recurrent loin pain and UTI.

**Investigations**

1. **IVU:** dilated pelvi-calyceal system with arrest of contrast at the PUJ.
2. **Diuretic renography:** to assess ability of the pelvis to empty after frusemide injection.
3. **Ultrasonography:** important if poor renal function → hydronephrosis.

**Treatment**

☞ **Assessment of the remaining renal function using DTPA renal scan is done:**

- **If kidney function is preserved** → emergency intervention is not needed.
- **In cases of poor renal function** →
  1. A trial of nephrostomy drainage should be considered with reassessment of renal function.
  2. To correct the obstruction surgically, pyeloplasty is needed. **Anderson-Hynes** pyeloplasty is the most common operation performed.
  3. Nephrectomy in case of hopeless kidney function.



# Urethral stricture

## Etiology

### Congenital

1. Posterior urethral valve.
2. Meatal stenosis.
3. May be associated with hypospadias.

### Inflammatory

1. **Following STDs especially gonorrhea** (commonly affecting bulbar urethra, 70%).
2. Bilharziasis.
3. Rarely tuberculosis.

### Traumatic

1. Rupture of urethra.
2. Iatrogenic injuries due to prolonged indwelling urethral catheters, transurethral surgical or diagnostic procedures.
3. Post-operative urethral stricture following prostatectomy or amputation of the penis.

### Neoplastic

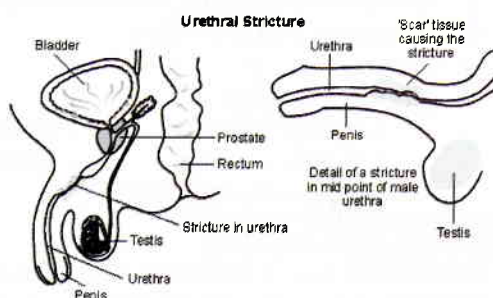
Urethral polyps - Venereal warts - Carcinoma of the urethra.

## Clinical picture (as BPH)

- Difficulty in micturation:
  - The patient has to strain to pass urine.
  - The stream is thin and weak.
  - There is terminal dribbling of urine trickling from the dilated urethra.
- Occasional passage of urethral discharge formed mainly of desquamated epithelium.
- Frequency of micturation due to incomplete evacuation of the bladder or due to cystitis.
- Retention of urine: this may occur as acute or chronic retention.
- It may be possible to palpate the scarring along the line of the urethra.

## Complications

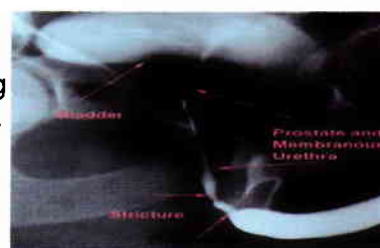
1. Retention of urine.
2. Urethral diverticulum.
3. Extravasation of urine with peri-urethral fistula.
4. Stone formation.
5. Infertility.
6. Infection e.g. urethritis, cystitis...etc.
7. Squamous cell carcinoma.
8. Renal insufficiency.
9. Straining → precipitating hernia, hemorrhoids...etc.



## Investigations

### For diagnosis

1. Urethrography using a water-miscible gel containing contrast medium shows the extent & severity of stricture.
2. Urethral ultrasonography.
3. IVU to assess the renal condition.
4. Urethrocystoscopy.





**For complications**

1. **Uroflowmetry** reveals obstructed flow.
2. Urine analysis: pyuria.
3. KFTs.

**For the cause**

- Urine analysis: bilharzial ova.

**Treatment**

**There is a danger to pass a urethral catheter as it will result in a false passage**

**Urethral dilation**

- Under absolute sterile condition and after instillation of a local anesthetic in the urethra.
- Dilatation is performed very gently.
- Dilatation usually starts with gum elastic bougies or even filiform bougies in very narrow stricture. Metal bougies can be used later.
- If a filiform bougie can't be passed on three successful occasions, the stricture is considered to be impassable.

**Internal urethrotomy**

- Through the urethroscope and under direct vision, the stricture is incised with sharp knife blade usually at the 12 O'clock position.

**Urethroplasty**

- This procedure is applicable for strictures of penile urethra if previous measures failed.
- The principle is to excise the fibrous tissue of the stricture and then to construct a new urethra using skin flaps from the penis, scrotum or perineum.

## Children with obstructive uropathy

**Etiology**

1. Pelvi-ureteric junction obstruction (most common cause).
2. Uretero-vesical junction obstruction e.g. ureterocele.
3. Posterior urethral valve.
4. Calculi.
5. Unusual causes:

|                             |                             |                       |
|-----------------------------|-----------------------------|-----------------------|
| - Ureteric stricture.       | - Ureteric polyp.           | - Retrocaval ureter.  |
| - Ureteric valves.          | - Bladder neck obstruction. | - Urethral stricture. |
| - Retroperitoneal fibrosis. |                             |                       |

**Clinical picture**

- Abdominal pain ± palpable abdominal mass (hydronephrotic kidneys or distended bladder).
- Clinical picture of complications e.g. UTI, hematuria...etc.

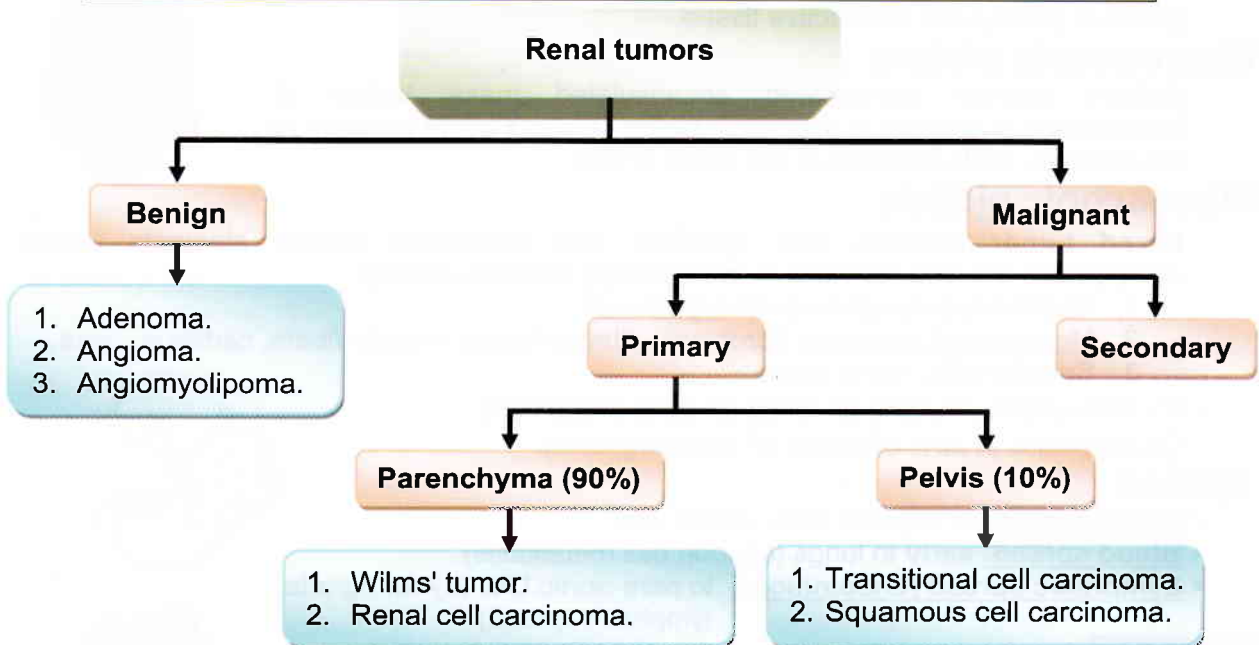
**Investigation**

1. **Plain x-ray:** may show calculi or soft tissue mass.
2. **Renal ultrasound:** it shows dilatation of pelvi-calyceal system, ureters, bladder or posterior urethra. It evaluates renal size, renal cortex, and renal scars. It is also useful to assess residual urine. It is important to assess abdominal masses.
3. **DTPA scan:** it shows differential renal function and can diagnose renal obstruction.
4. **Micturating cystourethrogram:** exclude vesico-ureteric reflux & posterior urethral valve.
5. **Intravenous urography:** show anatomical abnormality before surgical intervention.



# Tumors of urinary tract

## A- Renal tumors



## Wilms' tumor (Nephroblastoma)

### Incidence

- It represents about 10% of childhood malignant tumors.
- **Age:** usually below 5 years (median age = 3-4 years). 90% of cases occur below 7 years old.
- It is the 4<sup>th</sup> malignancy in children following leukemia, CNS malignancy & lymphoma.
- **Sex:** almost equal in both sexes.
- It may be familial in 1 – 2% of cases.

- ▶ The 2nd commonest tumor affecting the kidney and the 4th malignancy affecting children
- ▶ Bilateral in 5-10% of cases, early invades the capsule, of good prognosis
- ▶ **C/P:** • The main presentation is an abdominal mass, vague abdominal pain,
  - Microscopic hematuria
- ▶ **Inv.:** U/S, spiral CT
- ▶ **TTT:** depends on operable or inoperable

### Commonest childhood malignancy:

1. Leukemia (acute lymphoblastic).
2. CNS tumors.
3. Lymphoma.
4. Wilms' tumor and neuroblastoma.

## Pathology

### Site

- May be bilateral in 5 – 10%.

### Origin

- Embryonic nephrogenic tissue containing both epithelial cells from primitive glomeruli & connective tissue.

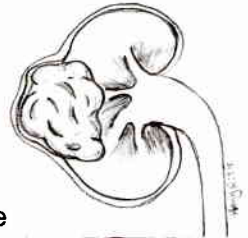
### Macroscopic picture

- Solitary sharply demarcated encapsulated mass, areas of hemorrhage & necrosis + grayish or pinkish white + **early** invasion of the capsule, while invasion of the pelvis is **late**.



### Microscopic picture

- **Mixed tumor** contains both epithelial and connective tissues elements (some components are less sensitive to radiotherapy than the others):
  1. Abortive tubules and abortive glomeruli.
  2. Mesodermal elements: fibroblasts, fibrous tissue, muscle fibers, cartilage, bone.
  3. Spindle cells, round cells.
- It's differentiated in 80% of cases (of good prognosis).
- Or anaplastic in 20% of cases (of bad prognosis).



### Spread

- **Direct spread**: to capsule early, pelvis late.
- **Blood spread**: **early** to lungs (cannon ball metastasis).
- **Lymphatic spread (uncommon)**: to para-aortic LNs (by retrograde lymphatic spread).



### Staging

- a. Confined to the kidney.
- b. Extends beyond the kidney but is completely excised.
- c. Residual non-hematogenous tumor confined to the abdomen.
- d. Hematogenous metastasis.
- e. Bilateral renal involvement at diagnosis.

### Clinical picture

- 1- The main presentation (90%) is an abdominal mass which is smooth, firm & is confined to one side of the abdomen.
- 2- One third of patients present with vague abdominal pain, often associated minor trauma & hemorrhage within the tumor.
- 3- **Microscopic** hematuria occurs in 50% of cases.
- 4- Hypertension is present in up to 60% of cases. It results from encroachment on the blood supply producing renal ischemia & excess renin production.
- 5- **Associated syndromes in familial type.**

#### ➔ Anomalies that may be associated with Wilm's tumor

- Aniridia in 2% of cases.
- Hemihypertrophy in 3% of cases.
- Macroglosia.
- Neurofibromatosis.
- Genito-urinary anomalies in 4.4% of cases.

## DD

1. **Neuroblastoma** (childhood supra-renal tumor with bone secondaries, enolase +ve, VMA in urine +ve and treated as Wilms' tumor).
2. Hepatoblastoma.

## Investigations

## For diagnosis

1. U/S (pelvi-abdominal)  $\pm$  percutaneous needle biopsy.
2. CT scan (spiral)  $\rightarrow$  Can assess tumor response to chemo and radiotherapy.
3. Plain urinary tract (PUT)  $\rightarrow$  soft tissue shadow with crescentic calcification.
4. IVU  $\rightarrow$  **displaced** pelvi-calyceal system (rarely invaded).
5. Ascending pyelogram to diagnose early changes in the pelvis.
6. Renal angiography to differentiate cysts from solid swelling (now replaced by CT).
7. Urine analysis  $\rightarrow$  hematuria.
8. Catecholamines are within normal.

## For staging

1. CXR.
2. Bone scan.
3. Pelvi-abdominal U/S.

## For preoperative preparation

1. CBC  $\rightarrow$  anemia, high ESR.
2. KFTS, LFTS, FBS, CXR, ECG.

## Treatment

## A- Surgical treatment:

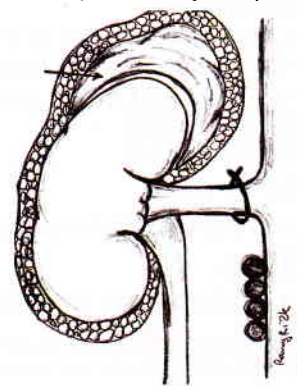
- Surgical excision remains the cornerstone of therapy in all children with wilm's tumor.

1. For operable tumor:

- The affected kidney is radically resected as for renal cell carcinoma.

2. For large unresectable lesions

- A course of preoperative chemotherapy usually shrinks the tumor, which can then be removed.
- Remaining tumor in nodes or adjacent tissues should be marked with surgical clips to facilitate direction of radiation therapy.



## B- Post-operative treatment:

- If there is no residual tumor  $\rightarrow$  adjuvant chemotherapy, using actinomycin D, vincristine & adriamycin is given.
- If there is residual tumor  $\rightarrow$  radiotherapy is added for local control.

## Prognosis

- Chemo & radiotherapy have improved the overall prognosis to 80% 5-year survival. Early cases are usually cured.

*Recurrences usually occur within a year, so a child surviving for 18 months or more is probably cured.*

# Renal cell carcinoma

(Hypernephroma)/(Grawitz's tumor)

## Incidence

- 75% of renal tumors, the most common tumor of the renal parenchyma.
- Age: usually between 50-70 years.
- Sex: more in males (M:F = 2:1).
- Bilateral tumors are synchronous or metachronous and occur in 1-2% of cases.

## Etiology

- Loss of short arm of chromosome 3.
- Smoking increase incidence by 2 folds.
- Von-Hippel Lindau disease. In these patients it may be multiple and bilateral.

## Pathology

### Site

- Usually unilateral **mainly from upper pole**.

### Origin

- Epithelium of **proximal convoluted tubules**.

Hypernephroma is a misnomer as it was thought to arise from supra-renal remnants

## Macroscopic picture

- Mass (**mainly from upper pole of kidney**) infiltrating edge, area of hemorrhage & necrosis + golden yellow color (or dull white) due to high lipid content + semitransparent + usually invades the pelvis **early**, capsule **late**.



## Microscopic picture

### ▪ Adenocarcinoma:

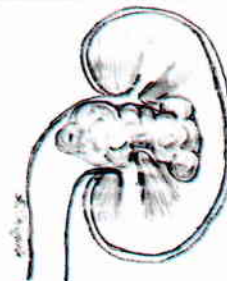
#### a. Cells:

1. Form acini or sheets with signs of mitosis and loss of polarity.
2. The cells may be **clear** (due to lipid, cholesterol and glycogen content) or **granular**.

#### b. Vascular CT.

## Spread

- **Direct spread:** early to the pelvis, late to the capsule.
- **Lymphatic spread:** to para-aortic LNs, Virchow's LNs (by retrograde lymphatic spread).
- **Blood spread:**
  1. Lung (cannon ball in the X-ray).
  2. Liver, bone.
  3. Within the renal vein & IVC like **finger in gloves** → 2ry varicocele.





### Staging

- Stage I → Tumor confined to the kidney.
- Stage II → Tumor confined to Gerota's fascia and involves the perinephric fat.
- Stage III → Tumor involves the renal vein and/or regional L.Ns.
- Stage IV → Distant metastases.

### Clinical picture

#### 1- Hematuria:

- Is present in 50% of cases with painless, recurrent, profuse & total hematuria.
- Sometimes, the blood passes as tubular clots taking the shape of ureter.

#### 2- Pain:

- Is present in 40% of patients. It may be due to :
- Stretch of the renal capsule by the neoplasm.
- Passage of blood clots causing ureteric colic.
- Infiltration of adjacent lumbar nerves causing referred pain.

#### 3- Renal mass:

- Irregular, hard, renal swelling in 30% of cases.
- The classic triad of hematuria, pain & renal mass is present in 10% of cases and usually indicates an advanced disease.
- Other uncommon presentation

#### 4- Metastasis. May be the first presentaion e.g.Pulmonary deposits.

#### 5- Non specific symptoms as fever,night sweats,& anemia.

#### 6- Secondary varicocele: rapidly enlarging varicocele which does not empty on elevation of the scrotum.

#### 7- Systemic syndromes

- Hypercalcemia occurs in 5% of cases due to secretion of parathormone like substance by the tumor or due to presence of bone metastasis.
- Polycythemia.
- Amyloidosis.

### DD

1. Hydronephrosis.
2. Polycystic kidney.
3. Liver swellings (on the right side) or splenic swellings (on the left side).

### Investigations

#### For diagnosis

- CT scan (spiral).
- U/S (abdomino-pelvic) → biopsy → for diagnosis and staging.
- Plain urinary tract (PUT) → obliterated psoas shadow.
- IVU → pelvi-calyceal system is Dilated, Enlarged Amputated & Distorted (DEAD) → (Irregular spider leg deformity).
- Ascending pyelogram to diagnose early changes in the pelvis.
- Renal angiography differentiates benign from malignant swellings (now replaced by CT).
- Urine analysis → hematuria.

#### For staging

- CT scan, bone scan.
- CXR: cannon ball metastasis.





**For preoperative preparation**

- CBC → anemia, polycythemia (4%), high ESR.
- KFTs, LFTs, FBS, ECG & CXR.

**Treatment****1. For early operable cases (stages I & II):**

- ⇒ Surgery offers the only hope for cure.
- ⇒ Radical nephrectomy is done. It entails removal of the kidney within its sheath of Gerota's fascia together with the ipsilateral adrenal gland.
- ⇒ It is recommended to expose & ligate the vascular pedicle as a first step of the operation for:
  - Prevention of dissemination of malignant cells during manipulation of the tumor.
  - To have good control on a very vascular tumor.
  - To be able to remove a malignant thrombus from the inferior vena cava, if present.

**2. Advanced disease**

- ⇒ Patients who have metastatic disease may receive symptomatic treatment e.g. analgesics, irradiation & immunotherapy using alpha or gamma interferons & IL-2.

**Prognosis**

- Removal of even the largest neoplasm may cure the patient.
- In operable cases 70% of patients are well after 3 years and 60 % after 5 years.
- Worse prognosis with:
  - Macroscopic involvement of the renal vein or its tributaries.
  - Tumor invasion beyond the capsule.
  - Lymph node involvement.

|                       | WILM'S                                                                                                                                                               | RCC                                                                                                       |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Incidence</b>      | - 10% of childhood malig.<br>- 3 – 4 yrs old<br>- ♂ = ♀                                                                                                              | - 75% of renal tumors<br>- 50 – 70 yrs old<br>- More in ♂                                                 |
| <b>Pathology</b>      | - Bilat 5 – 10 %<br>- Embryonic tissues<br>- Early capsule & Late pelvis<br>- Mixed tumor                                                                            | - Mainly untilateral<br>- PCT<br>- Early pelvis & Late capsule<br>- Adenocarcinoma                        |
| <b>C/P</b>            | - <b>Main present:</b> abd. Mass<br>- <b>Associated \$:</b> familial types<br>- pain, hematuria, HTN.                                                                | - <b>Main present:</b> hematuria<br>- <b>Associated \$:</b> paramalignant<br>- pain, mass, 2ry varicocele |
| <b>Investigations</b> | - IVP: displaced pelvi-calyceal system (rarely invaded)<br>U/S + CT + Ascending pyelogram + PUT + Staging + Preoperative.....→                                       | - IVP: DEAD                                                                                               |
| <b>Treatment</b>      | - <b>Operable:</b> Radical resection<br>- <b>Inoperable:</b> chemotherapy then resection + radiotherapy for malignant LN<br>→ Post-op.: chemotherapy or radiotherapy | - Radical nephrectomy.<br>- In advanced tumors: symptomatic TTT                                           |
| <b>Prognosis</b>      | 80 % 5 year survival                                                                                                                                                 | - 60 % 5 year survival<br>- 70% 3 year survival                                                           |

## Papillary transitional cell tumors of the renal pelvis

- They tend to invade the renal parenchyma and have a tendency to distant spread.
- There is a strong tendency for the tumors to be multifocal.
- Seeding down the lumen of the urinary tract may give rise to multiple ureteric tumors, but the condition is thought to arise from a field change, which renders the whole urothelium liable to metaplasia.

### Diagnosis

1. Hematuria.
2. Urine cytology.
3. Intravenous urography usually demonstrates the tumor.

### Treatment

- Conventional surgical treatment is by nephro-ureterectomy.

## Squamous cell carcinoma of the renal pelvis

- Rare and often associated with chronic inflammation & leucoplakia resulting from stones.
- The tumors are radiosensitive but metastasis at an early stage.
- Prognosis is poor.

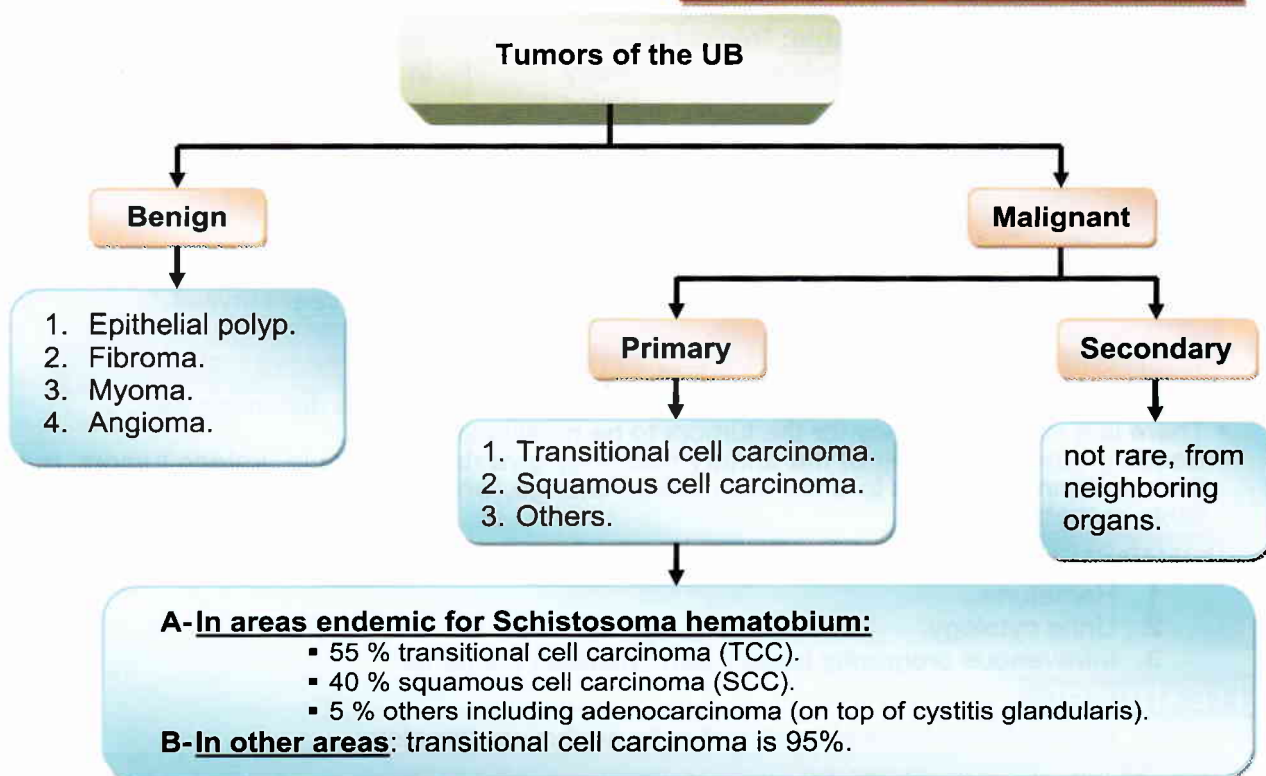
## Transitional cell tumors of the ureter

- Rare, behave like tumors of the renal pelvis.
- Treatment → by nephro-ureterectomy.

## B- Urinary bladder tumors

- ▶ Common in male than females
- ▶ SCC occurs in young age with TCC occurs in old age
- ▶ **PDF:** chronic irritation, chronic infection, precancerous lesion
- ▶ **C/P:** Terminal hematuria, necroturia, frequency and dysuria
- ▶ **Inv.:** cysto-urethroscopy+ multiple biopsies
- ▶ **TTT:** **a. SCC :** Radical cystectomy  
**b. TCC:** depends on invasive or non invasive

### Tumors of the UB



➔ U.B carcinoma is the most common urological malignancy in Egypt

## Squamous cell versus Transitional cell carcinoma

|                             |                    | SCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | TCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Age</b>                  |                    | 20 – 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | > 60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Sex</b>                  |                    | Male : Female<br>4 : 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Male : Female<br>3 : 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Predisposing Factors</b> |                    | <b>a. Chronic irritation:</b> <ul style="list-style-type: none"> <li>- <u>Mechanical</u>: by ova or stones.</li> <li>- <u>Chemical</u>: by metabolites (N-Nitrose compound, tryptophan, serotonin).</li> </ul> <b>b. Chronic infection:</b> especially with ammonia-producing organisms. <b>c. Abnormalities of tryptophan metabolism.</b> <b>d. Precancerous lesions:</b> <ul style="list-style-type: none"> <li>- Brunn's nests.</li> <li>- Cystitis cystica.</li> <li>- Leucoplakia &amp; squamous metaplasia.</li> </ul> | <b>a. Chronic irritation:</b> <ul style="list-style-type: none"> <li>- <u>Chemical</u>:               <ul style="list-style-type: none"> <li>▪ Smoking ↑ the risk by 2-4 folds.</li> <li>▪ Industrial carcinogens (e.g. aniline dye).</li> <li>▪ Chemotherapy (cyclophosphamide) ↑ the risk 9 folds.</li> </ul> </li> <li>- <u>Physical</u>: pelvic irradiation.</li> </ul> <b>b. Genetic:</b> <ul style="list-style-type: none"> <li>- Activation of oncogenes e.g. RAS &amp; Cerb B-2.</li> <li>- Inactivation of tumor suppressor genes e.g. P-53 (Li Fraumeni).</li> </ul> |
| <b>Pathology</b>            | <b>Site</b>        | <ul style="list-style-type: none"> <li>▪ Usually at the posterior &amp; lateral walls</li> <li>▪ Not at trigone</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>▪ Usually at the base and around ureteric orifices.</li> <li>▪ At the trigone</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                             | <b>Macroscopic</b> | Fungating mass (common)<br>Malignant ulcer<br>Papillary mass (rare)                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Papillary mass or papillae,<br>Ulcer.<br>Nodule.<br>Localized erythematous patches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                             | <b>Microscopic</b> | SCC → Cell nests if well differentiated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>TCC is classified into:</b> <ol style="list-style-type: none"> <li>1. Superficial TCC (75%): commonly papillary type.</li> <li>2. Muscle invasive type (25%).</li> <li>3. Carcinoma in situ (CIS) (<b>associated</b> in 5% of the cases).</li> </ol>                                                                                                                                                                                                                                                                                                                        |
|                             | <b>Spread</b>      | See below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

### Staging SCC of UB

#### ➔ Wallace staging system for SCC is based on bimanual clinical examination

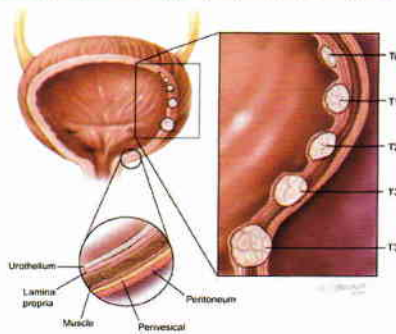
- T0 → No palpable mass.
- T1 → Palpable mobile mass with no induration of bladder wall.
- T2 → Palpable mass with induration of the bladder wall.
- T3 → Palpable mobile wall with extravesical spread.
- T4 → Fixed bladder mass.

**Histological grading:**

1. Low grade (well differentiated cells).
2. Medium grade (moderately differentiated cells).
3. High grade (poorly differentiated cells).

**Complications****Spread (especially with muscle invasive type)**

- ⇒ **Direct spread to the surroundings:** prostate & seminal vesicles in males, vagina & uterus in females, pubic bone, abdominal wall, bowel & omentum, pelvic wall, sacral plexus & iliac vessels, pelvic fascia and rectum.
- ⇒ **Blood spread:** to the lungs, liver & bones.
- ⇒ **Lymphatic spread:**
  - Perivesical LNs → internal iliac LNs → common iliac LNs → para-aortic LNs → thoracic duct → Virchow's.



Lymphatic spread in SCC on top of bilharziasis is delayed due to fibrosis & calcification in the bladder & peri-vesical tissue & local LNs

**Others (in order of frequency)**

- Ulceration.
- Hemorrhage.
- Infection.
- Fistula formation.
- Urinary tract obstruction.

**Clinical picture****Symptoms**

➤ **The patient usually presents with exacerbation of symptoms of cystitis.**

- 1- **Hematuria: (terminal)**
  - Does not attract the attention of patient in cases of SCC on top of bilharziasis & the hematuria is **painless** in cases of TCC.
  - It is painful in SCC.
- 2- **Necroturia:** passage of pieces of whitish tissue (fish odor).
- 3- **Frequency and dysuria:**
  - Commonly occur with muscle invasion.
  - With CIS, symptoms may be very severe (malignant cystitis).
- 4- **Pain (late):**
  - Deep seated pelvic or supra-pubic pain (usually with muscle invasion).
  - Sciatica (with pelvic wall invasion).
  - Loin pain due to ureteric obstruction → hydronephrosis or pyonephrosis.
- 5- **Abnormal presentations:**
  - Cachexia, **anemia**, metastasis, **repeated attacks of lower UTI**, retention of urine by a pedunculated tumor or a clot, late → uremia.

Symptoms of Bilharziasis of the UB and UB cancer are overlapping → so if a patient is known to have urinary Bilharziasis and complains of aggravation of symptoms, the possibility of UB cancer should be excluded



## Signs

### a. General:

- Manifestations of complications.
- Cachexia, anemia, metastasis, fever if infected, late uremia.

### b. Local

- Bimanual examination under general anesthesia.
  - o To differentiated T<sub>2</sub> and T<sub>3</sub> (a palpable mass = T<sub>3</sub>)
  - o To assess local spread (prostate or vagina in T<sub>4a</sub>)



DD

- Urinary bladder stone.
- Cystitis.

## Investigations

### For diagnosis

1. **Cysto-urethroscopy + multiple biopsies:** from the tumor base & adjacent mucosa).
  - In TCC trans-urethral resection of visible tumor with biopsy of underlying muscle+ multiple random biopsies to diagnose carcinoma in situ.
2. **IVU:**
  - o Shows irregular filling defect or just irregularity in the bladder wall.
  - o May show manifestations of back pressure (hydroureter, hydronephrosis).
3. **Ascending cystography:** if IVU is contraindicated e.g. uremia.
4. **CT & U/S.**
5. **Urine analysis:**
  - o Cytology (shows Bilharzial ova, RBCs >5 /HPF, malignant cells).
  - o Hematuria, necroturia, pyuria.
  - o Culture & sensitivity.

### For staging

1. **CXR.**
2. **Bone scan.**

### For preoperative preparation

1. CBC → anemia and increased ESR.
2. K.F.Ts → uremia (in late cases).
3. LFTs → elevated ALP in metastasis.
4. FBS, CXR, ECG.

### Treatment (according to type)

#### I. SCC:

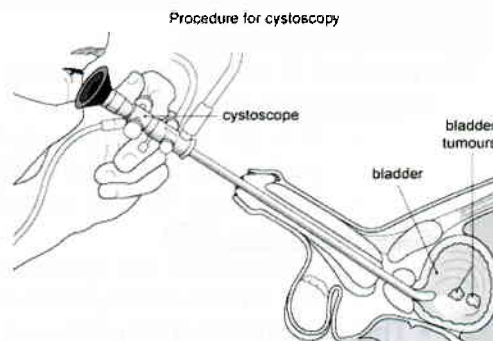
- Unfortunately in Egypt the diagnosis of SCC is made when the case is too advanced.
- SCC is chemo and radio resistant.
- The best chance is to treat it by radical cystectomy, but urethra is not removed.
- **Prognosis:**
  - The 5-year survival rate following radical cystectomy is 32%.

#### II. TCC:

##### A. Superficial bladder cancer:

##### ➤ Transurethral resection (TUR):

- Excision of the tumor with the underlying muscle plus multiple random biopsies to detect carcinoma in situ.
- Laser ablation may be used in place of TUR.



- Indications for Intra-vesical chemotherapy (adriamycin) or immunotherapy (BCG vaccine):
  1. Grade II and III tumors.
  2. Carcinoma in situ.
- **Prognosis**
  - Regular follow up for 5 years is indicated to detect recurrence.
- **Indications for radical cystectomy in this patient:**
  1. Multiple recurrences.
  2. Persistent carcinoma in situ.

### B. Muscle invasive:

- **Radical cystectomy.**
  - This operation differs from that prescribed for SCC in only one step; the urethra has to be removed because of the tendency of TCC to spread along the urethra.
- **Radiotherapy:**
  - The results are inferior to surgery.
- **Chemotherapy:**
  - For metastatic disease or when the surgical margins are not free. Best combination is methotrexate, vinblastine, adriamycin and cis-platin (MVAC).

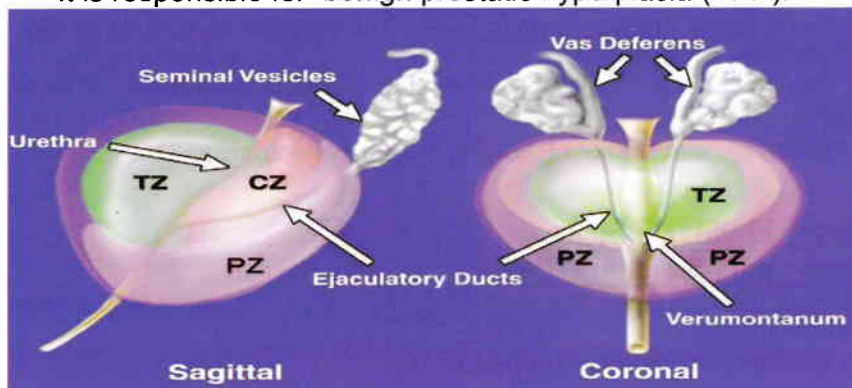
## Urinary diversion

- See differential diagnosis.

## Anatomy of the prostate

### Surgical anatomy

- The prostate is divided into 3 zones:
  - **Peripheral zone (PZ)**
    - It is the subcapsular portion of posterior aspect of the prostatic gland which surrounds the distal urethra.
    - More than 70% of poststatic cancers originate from it.
  - **Central zone (CZ)**
    - It surrounds the ejaculatory ducts as they pass through the prostate.
    - CZ tumors account for more than 25% of all prostate cancers.
  - **The peri-urethral transitional zone (TZ)**
    - It surrounds the proximal urethra.
    - It is responsible for benign prostatic hyperplasia (BPH).



# Enlargement of the prostate

## 1. Benign Prostatic Hyperplasia (BPH)

### Incidence

- 50% males above 50 years have histological evidence of BPH.
- 15% have lower urinary tract symptoms.

### Etiology

- The exact cause is unknown.
- Mostly, it is due to significant decrease in testosterone level with unequal decrease in estrogen level → increase estrogenic effect.
- Secretion of intermediate peptide growth factors may play role in development of BPH.

- ▶ Very common in old males however few cases present with lower urinary tract symptoms
- ▶ Mostly arise from submucous group of the gland in T.ZONE
- ▶ C/P: **a.Symptoms** : urinary symptoms ,sexual symptoms +symptoms of complications  
**b.Signs**: On DRE criteria of BPH
- ▶ **Investigations**: TRUS,PSA
- ▶ **TTT**: medical if failed surgical

### Pathology

#### Site

- Most commonly arises from submucous group of glands in transitional zone (peri-urethral) → lateral lobes.
- If arising from CZ sub-cervical glands → middle lobe.

### Macroscopic

#### A- Changes in the prostate:

- No gritty sensation during cutting it.
- Fibrous trabeculae divide the adenoma into lobules.
- Yellowish in color.

#### B- Changes in the urethra:

- The adenoma compresses the urethra producing:
  - 1<sup>st</sup>, urethral elongation.
  - Urethral narrowing as it is stretched and compressed from side to side. This narrowing interferes with bladder emptying.
  - Exaggeration of the normal posterior curve of the urethra.
- The urinary bladder, ureters and kidney show changes as in obstructive uropathy.

### Microscopic

- Hyperplasia of acini (fibro-myo-adenoma).
- Dried prostatic secretion → **corpora amylacia**.

### Clinical picture

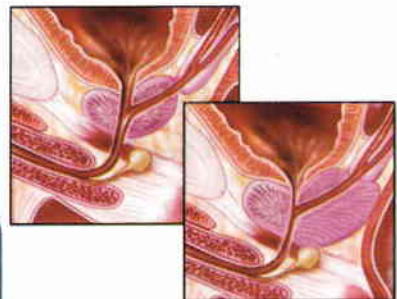
#### Type of patient

- Men over 50 years of age.

- There is no relation between the size of the prostate and degree of symptoms.
- Severity of symptoms depends on the degree of urethral and bladder neck obstruction.



Normal prostate



Benign prostatic hypertrophy (BPH)

**Symptoms (STAGES)****a) Asymptomatic.****b) Symptomatic:****I. Urinary symptoms:****1- Frequency of micturation:**

- a. Usually the earliest complaint.
- b. At first nocturnal, later on day & night.

**⇒ Causes:**

- 1) Congestion of the trigone.
- 2) Detrusor irritability.
- 3) Elongation of sensitive posterior urethra exposes its mucosa to urine in the U.B.
- 4) Increased residual urine.
- 5) Inadequacy of the internal sphincter due to elongation.
- 6) Complications: cystitis, stones & trigonal irritation.

**2- Difficulty:**

- a. To start: straining increase the obstruction due to congestion and projection of middle lobe, so the patient learns to relax
- b. To maintain (abnormal stream): weak, interrupted, forked, deviated stream.
- c. To finish: in the form of dribbling of urine (residual urine).

**3- Retention of urine:**

- a. Acute retention of urine is sometimes the 1<sup>st</sup> presentation of BPH. Retention is precipitated by excess fluid intake, alcohol, cold weather, cystitis, diuresis, constipation, unrelieved sexual excitement. Acute retention is very painful and needs urgent intervention.
- b. Chronic retention with overflow incontinence. The condition is painless and the actual complaint of the patient is incontinence.

**4- Hematuria. Gross hematuria may occur due to rupture of one of the prostatic veins.****II. Sexual symptoms:**

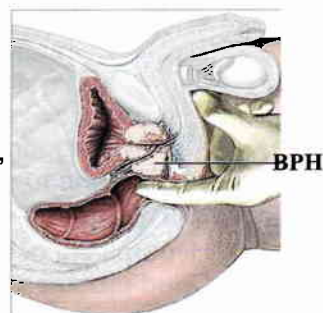
- Increased libido at the start, later on impotence is the rule.

**III. Symptoms of complications.****Signs****1. General:**

- Exclude complications (uremia, fever).
- Exclude DD (cystitis, cancer prostate with metastasis, neurological examination for DM and Parkinsonism).

**2. Local:**

- Mass or tenderness in the renal angle (hydronephrosis).
- Supra-pubic palpable bladder (retention).
- **DRE** → the prostate is benignly enlarged.

**Criteria of benign enlargement of the prostate**

1. **Soft.**
2. **Smooth.**
3. **Symmetrical.**
4. Median **sulcus** preserved.
5. Notch between it & **seminal vesicle** is preserved.
6. Mucosa of rectum mobile over prostate



Residual urine may be felt as a fluctuating swelling above the prostate (if there is considerable amount of residual urine, it pushes the prostate downwards making it appears larger than it is).

## Complications

### General

- Renal failure
- Psychological distress

### Local

- **Hematuria** due to rupture of vesical varices.
- **Back pressure** which leads:
  1. Retention of urine.
  2. Detrusor irritability → overactive bladder.
  3. Muscle hypertrophy and ↑ trabeculation of UB.
  4. Detrusor failure → residual urine (chronic retention).
  5. Bilateral hydronephrosis.
  6. Bilateral hydroureter.
  7. Diverticulum formation.
  8. Bladder stone.
  9. Cystitis.

### DD

- Cancer prostate.
- Other lower urinary tract diseases.
- Generalized disorders affecting the urinary tract (ex. DM, Parkinson's disease).

## Investigations

### For diagnosis

- **Trans-rectal U/S (TRUS)** (very accurate and non-invasive).
  - To uncover non-palpable malignancy in peripheral zone.
  - U/S guided biopsy can be taken.
- **PSA (prostatic specific antigen):**
  - More specific than acid phosphatase.
  - Normally 0 – 4 ng / ml.
  - If > 30 ng / ml → metastatic prostatic carcinoma.
  - If < 15 ng / ml → prostatic carcinoma confined to prostate or BPH.
- **IVU:**
  - Smooth basal filling defect in the bladder.
  - Hooking of the ureters on entering the bladder (fish-hook sign)
  - Trabeculations, sacculations and diverticulae.
  - Post voiding film → residual urine.
  - Exclude gross pathology of the urinary tract.
- Cysto-urethroscopy + biopsy. It is indicated in patients presenting by hematuria to exclude bladder pathology.





### For complications

- **Laboratory:**
  1. Urine analysis: hematuria, C & S.
  2. KFTs.
- **Imaging:**
  - Abdominal U/S → to visualize kidney changes, measure amount of post-voiding residual urine in the bladder and to diagnose any bladder pathology.
- **Instrumental:**
  - **Uroflowmetry** → maximum flow rate less than 15 ml/sec means bladder neck obstruction.

### Treatment

#### A- Medical treatment:

- Prostatic decongestant suppositories.
- Phytotherapy: A group of drugs of plant origin may improve symptoms.
- Alpha blocker e.g. Prazosin → relax smooth muscles of the capsule → relieve urethral obstruction. It improves frequency and flow rates.
- 5-alpha reductase inhibitor (Proscar ®). In those who improve on this treatment, this drug is continued for life.

#### B- Surgical treatment:

##### ↗ **Indications:**

1. Obstructed uroflow curves.
2. Acute retention of urine.
3. Chronic retention with residual urine more than 200 ml.
4. Hematuria.
5. Complications as stones.
6. Back pressure changes.
7. Distressing frequency.

##### ↗ **Methods:**

- **Pre-operative:**
  - Treatment of acute complications (e.g. UTI, Acute retention).
  - Antibiotics.

- **Operative:**

##### **1. Endoscopic surgery:**

- TURP (trans-urethral resection of the prostate).
  - It is the standard technique using cystoresectoscope.
  - The limitation is large adenoma.



- Recent methods to decrease bleeding:
  - VLAP (Visual LASER Ablation of Prostate by Holmium laser).
  - Transurethral heat prostatic vaporization.

☒ **Complications:**

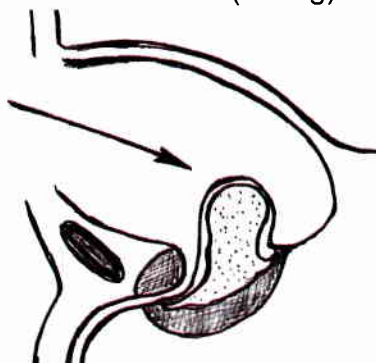
1. Bleeding is the main problem. It may be 1ry, 2ry or reactionary.
2. Retrograde ejaculation (more than 90%): due to injury of internal sphincter.
3. Incontinence, if the external sphincter mechanism is damaged.
4. Impotence (5%) due to injury of pudendal nerve.
5. Perforation to UB.
6. Sepsis, recurrence, stricture.
7. TURP syndrome.

### TURP Syndrome

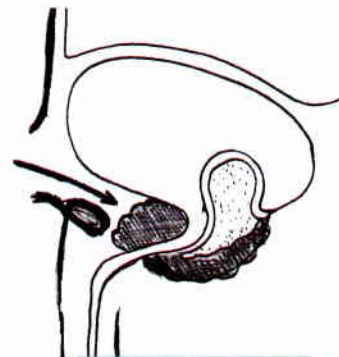
- **Etiology:** over absorption of the irrigating hypotonic fluid used during endoscopic resection of the prostate.
- **Effects:** hypervolemia, dilutional hyponatremia & intravascular hemolysis.
- **Prophylaxis:** use of Glycine (isotonic solution) for irrigation.

**2. Open surgery:**

- Trans-vesical prostatectomy (Fryer). Indicated when there is an associated bladder pathology that requires surgery.
- Retro-pubic prostatectomy (Millin).
- Perineal (Young) → not done now.



Trans-vesical



Retro-pubic

**3. Minimally invasive procedures:**

- The aim of these procedures is temporary relief of BPH when definitive treatment is contraindicated in high risk patients.

☞ **Methods:**

- Thermotherapy. Microwave heat therapy.
- Endoscopic transurethral cryo-ablation of the prostate.
- Endoscopic transurethral prostatic stents.

## 2. Carcinoma of prostate

### Incidence

- The most common cancer in ♂ > 65 years (androgen sensitive).

### Predisposing Factors

- +ve Family history.
- Fatty meals.
- Blacks have the highest incidence.

### Pathology

#### Site

- Outer zone of the posterior lobes (peripheral zone 75%).



- ▶ The most common cancer in ♂ > 65 years (androgen sensitive).
- ▶ Common in the posterior lobes (peripheral zone).
- ▶ C/P: a. **Symptoms:** Prostatism, symptoms of complication  
b. **Signs:** criteria of cancer prostate in DRE
- ▶ **Investigations:** TRUS + PSA
- ▶ **TTT:** according to the age of the patient, life expectancy and operability

### Macroscopic

- Gritty sensation on cutting.
- Hard infiltrating pale nodule.
- Mass with infiltrating edge + areas of hemorrhage & necrosis.
- Grayish in color.

### Microscopic

- Usually adenocarcinoma (95%).
- Scirrhus carcinoma.
- Rarely → anaplastic.
- There is a grading system of prostatic cancer (Gleason's grade) based on glandular differentiation and growth pattern. Grade 2 is the least malignant while grade 10 is the highest malignant.

### Spread

- See below.

### Staging

#### TNM

- **T0** → no clinical abnormality.
- **T1** → Nodule in one lobe.
- **T2** → Diffuse disease.
- **T3** → Extension to the seminal vesicles.
- **T4** → Lesion is fixed to other tissues.
- **N0** → No evidence of involvement of LNs.
- **N1** → Involvement of one regional node.
- **N2** → Involvement of several regional nodes.
- **N3** → Fixed mass of regional LNs.
- **N4** → Involvement of common iliac or para-aortic LNs.
- **M0** → No evidence of distant metastases.
- **M1** → Distant metastases.

## Clinical picture

- Early cancer prostate is asymptomatic but it may be found:
  - Incidentally following TURP (t1)
  - As a nodule on rectal examination (t2)

## Symptoms

Only advanced cases give rise to symptoms but even advanced cases may be asymptomatic

1. **Prostatism** (LUTs) (disturbance of function).
2. **Pain, which is:**
  1. Perineal.
  2. Supra-pubic, referred to the penis.
3. **Occult presentation:** due to metastasis e.g. pathological fracture.
4. **Symptoms of complications:** see later.

## Signs

1. **General:** cachexia, uremia.
2. **Local:**
  - Mass or tenderness in the renal angle.
  - Supra-pubic palpable bladder.
  - **DRE** (A normal DRE does not exclude carcinoma):
    - Hard.
    - Asymmetrical.
    - Median sulcus not preserved.
    - Notch between it & seminal vesicle is not preserved.
    - Mucosa of rectum: early mobile, late not mobile over the prostate (due to delayed invasion of the rectum).

## Complications

### Spread

There is delayed spread to the rectum due to presence of fascia of Denonvilliers (remnants of urorectal septum)

#### 1- Direct:

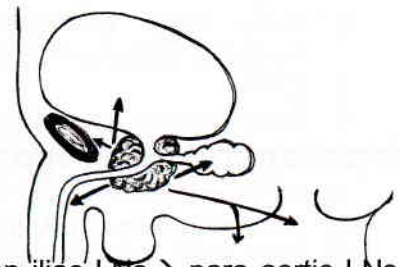
- Urethra.
- Seminal vesicles.
- Bladder.
- Ureteric obstruction occurs in 20% of cases.
- Perineum.
- Pubic bone.
- Sacral plexus.
- Iliac vessels.

#### 2- Lymphatic:

- Internal iliac and external iliac LNs → common iliac LNs → para aortic LNs → thoracic duct → Virchow's LNs. The obturator LN may be involved.

#### 3- Blood spread:

- 90 % of blood-born metastases occur in bone especially the lower vertebrae and pelvic bones and ribs (& even BM invasion → anemia and pancytopenia).
- This is due to reversal of blood flow from prostatic plexus (veins of Santorini) to the axial skeleton through valveless veins of Batson.
- It is usually osteoblastic.



Skeletal metastasis most commonly arises from malignancies in the prostate, breast, kidney, bronchi and thyroid gland

## Others

- 1) Hematuria which is less common.
- 2) Retention of urine might occur late.
- 3) Renal failure.
- 4) Back pressure: 1- Hydronephrosis. 2- Hydroureter.

## Investigations

### For diagnosis

#### 1. Trans-rectal U/S (TRUS):

##### ▪ Advantages:

- Accurate.                      - Non-invasive.                      - Best method for **local staging**.
- Can be used in early detection of tumors in screening programs.

##### ▪ Biopsy can be taken

##### ▪ Must be done to any patient with abnormal DRE and or elevated PSA.

#### 2. IVU: shows irregular filling defect at the base of UB and may show back pressure effects.

#### 3. Tumor markers:

##### ⇒ PSA:

- More specific than acid phosphatase.
- >15 ng /ml → suggestive for prostatic carcinoma.
- >20 ng /ml → is diagnostic of advanced prostate cancer.
- (PSA may be -ve in 20% therefore it is mainly used for follow up).

##### ⇒ Acid phosphatase: Raised in 70% of cases with extracapsular or metastatic disease. After DRE the acid phosphatase remains elevated for 24 hours.

#### 4. Urodynamic study for bladder neck obstruction.

#### 5. Urine analysis → RBCs.

### For staging

1. TC<sub>99</sub> bone scan (especially if PSA > 20 ng /ml).
2. X-ray spine: characteristic osteosclerotic lesions with or without pathological fractures (lesions may be osteolytic).
3. CXR.
4. Bone marrow aspiration → presence of metastatic carcinoma cells.

### For preoperative preparation

- 1) KFTs → exclude renal failure.
- 2) Liver enzymes (ALP, gamma GT → increase if liver metastasis).
- 3) CBC, FBS, CXR & ECG.

### For screening

##### ⇒ By PSA → controversial.

TURS together with rectal examination and measurement of PSA will detect only 30 – 50% of cancers that are known to be present o autopsy studies



**Treatment**

⇒ **Choice of treatment depends on:**

- 1) Staging of the disease.
- 2) Life expectancy and the age of the patient.
- 3) Patient's will.

**A. Early (operable cases) → T1 & T2:**

**In elderly patient with life expectancy < 10 year, watchful waiting is the treatment of choice**

➤ Radical prostatectomy:

- Removal of prostate, seminal vesicles and pelvic LN (obturator, internal and external iliac LNs). The bladder neck is reconstituted and anastomosed to the urethra.
- **Side effects:** impotence (high incidence), severe stress incontinence (low incidence).

Recent modification by preservation of neuromuscular bundle (which lies behind the prostate) led to preservation of erectile function in about 60 – 70% of cases

➤ Radical radiotherapy:

• **Side effects:**

- Bladder irritation → frequency & urgency.
- Rectal irritation → diarrhea or bleeding per rectum.

**B. Advanced (inoperable cases) → T3 & T4:**

➤ Palliative TURP.

➤ Hormonal therapy:

⇒ This is the mainstay of treatment in cases of advanced or unfit or unwilling patient for surgery or radiotherapy.

⇒ **Principle:** prostatic cancer is androgen sensitive; there are different methods for androgen ablation:

- a- Bilateral orchidectomy (removal of testes with tunica albuginea) or bilateral orchiectomy (removal of testes only).
  - Side effects: loss of libido & erectile dysfunction.
- b- Estrogen: phosphorylated DES (Honvan®) → still increases risk of thrombosis.
- c- LHRH agonist: The drug causes initial rise of the level of testosterone for 4-6 weeks then drops to castrate level. - Expensive.
- d- Anti-androgen (Nutilamide®).

**C. Treatment of metastasis:**

1. Radiotherapy (if multiple bone metastasis → IV strontium-89 which is a bone-seeking isotope to deliver effective radiotherapy to metastatic areas).
2. Internal fixation for pathological fracture.

☒ No treatment in cases of small well differentiated tumors in elderly men may be managed by watchful waiting, particularly if their life expectancy is less than 10 years.

**Prognosis**

- 1- With localized tumors to the prostate, the 10-year survival rate is 50%.
- 2- If metastasis is present, the 10-year survival rate drops to 10%.

|                       | BPH                                                                                                                                                    | CANCER PROSTATE                                                                                               |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Incidence</b>      | 50% of ♂ above 50 yrs old                                                                                                                              | Most common cancer in ♂ > 65 yrs                                                                              |
| <b>Etiology</b>       | Unknown<br>(Mainly growth factors)                                                                                                                     | - Black - Fatty meals<br>- +ve F.H.                                                                           |
| <b>Site</b>           | Lateral, middle lobes                                                                                                                                  | Posterior lobes                                                                                               |
| <b>Macroscopic</b>    | - Yellowish<br>- No gritty sensation<br>- Fibrous trabeculae                                                                                           | - Greyish<br>- Gritty sensation<br>- Mass + Hge. + necrosis                                                   |
| <b>Microscopic</b>    | - Hyperplasia of acini<br>- Corpora amylacea                                                                                                           | Adenocarcinoma (95%)                                                                                          |
| <b>C/P</b>            | 1. Prostatism { Urinary: Frequency, Difficulty, Retention, Hematuria<br>Sexual: ↑ libido → impotence<br>2. Complications<br>3. DRE: benign enlargement |                                                                                                               |
| <b>Investigations</b> | Transrectal U/S + PSA + Acid phosphatase + IVP + urodynamic studies<br>Biopsy (staging, screening) + Comp. + Pre-op. +                                 |                                                                                                               |
| <b>Treatment</b>      | - <u>Medical</u> : supportive<br>- <u>Surgical</u> : TURP                                                                                              | - <u>Early</u> : Radical prostatectomy or<br>Radical radiotherapy<br>- <u>Late</u> : TURP or hormonal therapy |

## Hematuria

➡ See differential diagnosis.

### VIP Notes

#### Kidneys

- ❑ Flower vas appearance in IVP is seen in horseshoe kidney.
- ❑ The cause of ureterocele is congenital atresia of ureteric orifice.
- ❑ Hematuria following trivial blunt trauma of kidneys indicates previously pathological kidneys.
- ❑ Closed renal injury is always extraperitoneal.
- ❑ Contusions are best treated with → observation until hematuria subsides.
- ❑ Lacerations 2ry to blunt trauma don't always require exploration:
  - Confined to cortex → no exploration.
  - Extending to calyceal system → requires exploration.
- ❑ Indications of IVP following abdominal trauma:
  - a. Blunt trauma to abdomen, back
  - b. With microscopic hematuria
  - c. With macroscopic hematuria.

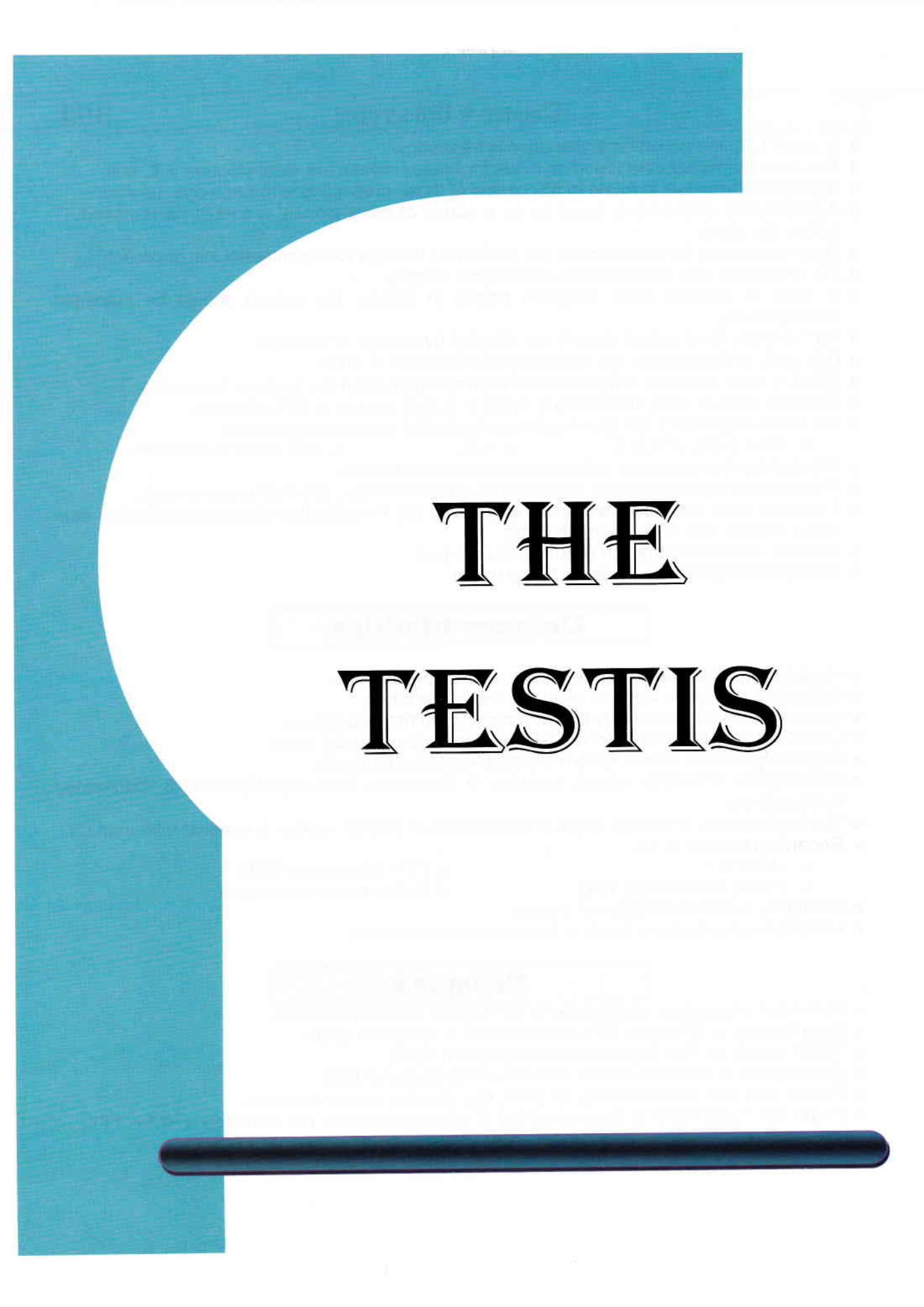
- In renal T.B., the earliest manifestation is frequency.
- The commonest bacteria found as nidus for urinary stones are staphylococci & E. coli.
- Hyperparathyroidism is found in 5% or less of those presenting with radio-opaque stones.
- If parathyroid adenoma is found to be a cause of renal stones, it should be removed 1<sup>st</sup> before the stone.
- Open operations for renal stones are performed through extraperitoneal loin approach.
- 1% of patients with ureteric stone need open surgery.
- In case of bilateral silent staghorn stones in elderly, the patient should be managed conservatively.
- $\text{Ca}^{++}$  oxalate renal calculi doesn't get affected by change of urine pH.
- Uric acid, cystine stones are treated by alkalinization of urine.
- ESWL's most common complication is urethral obstruction 2ry to stone fragments.
- Classical triad of: pain, hematuria & mass in R.C.C. occurs in 10% of cases.
- For assessing R.C.C. CT (the most important initial assessment) shows:
  - a. Size & site of R.C.C.
  - b. L.N.
  - c. IVC, renal V. invasion.
- Transabdominal approach to kidney is advisable in tumors.
- Pretreatment to unresectable wilm's tumor is radiotherapy, chemotherapy or both.
- 6 months child with left sided abdominal mass, the investigation showed calcification near the Lt. kidney, this is → Neuroblastoma.
- Bilateral ureteric obstruction occurs in cancer [cx].
- Retroperitoneal fibrosis involves 1<sup>st</sup> the ureter.

## Urinary bladder

- Hypertrophy of detrusor muscle causes U.B. trabeculations.
- Epithelium of trigone involves proximal ureter & urethra.
- Internal sphincter prevents retrograde ejaculation not incontinenc.
- Distal urethral sphincter receives 52 – 54 fibers via pudendal nerve.
- Regarding bladder calculi → its incidence has fallen markedly.
- Carcinogens of bladder cancer includes → Benzidine, Beta-naphthylamine & Chlorinated hydrocarbons.
- The best method to assess depth of penetration of bladder cancer is contrast enhanced CT.
- Regarding bladder C.I.S.:
  - a. More in ♂.
  - b. Poorly differentiated TCC
  - c. TTT: intravesical BCG.
  - d. Higher tumor recurrence.
- Strangury is due to irritation of trigone.
- Uretero-segmoidostomy leads to hyperchloremic acidosis.

## Prostate

- Formation of prostatic middle lobe in BPH arises from central zone.
- Drug therapy in BPH gets 20% improvement in symptom score.
- TURP results in 75% improvement in symptom score.
- Assessment in prostatic cancer includes cross sectional MRI.
- Patient who had prostatectomy for BPH, can develop cancer prostate.
- 75 yrs old ♂ got TURP & discovered foci of adenocarcinoma, the next step is → No TTT.



# THE TESTIS

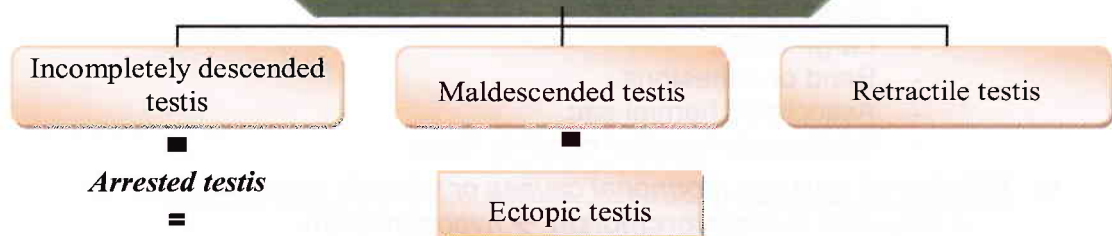
# Anatomy

➡ See surgical anatomy book.

## A-Diseases of Testis

### Congenital Anomalies of Testis

#### 1. Imperfect descent of the testis



#### Undescended Testis

2. Anorchia / Hypoplasia (rare).
3. Inversion of the testis means alteration of the normal position of the epididymis

#### a. Anterior inversion

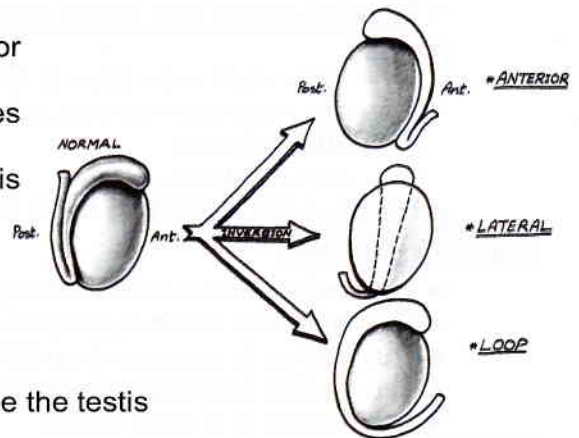
1. Epididymis is attached to the anterior border
2. Testis & tunica vaginalis lies posteriorly
3. TB sinus can open anteriorly in this case only.

#### b. Lateral inversion

The epididymis is attached to the lateral surface of the testis.

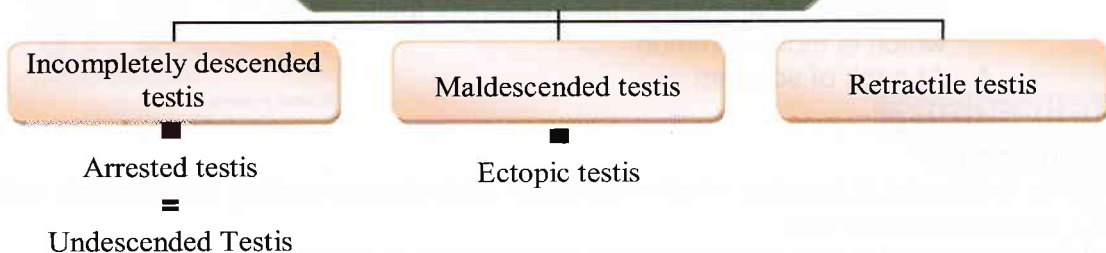
#### c. Loop inversion

The epididymis & ductus deferens encircle the testis



## Imperfectly Descended Testis

#### 1. Imperfect descent of the testis





# A-Incompletely Descended Testis

## Definition

- The testis is arrested at any site on the **normal** pathway to the scrotum.
- Better to be called **arrested testicle**.

## Etiology

⇒ **Unilateral cases:** (*mechanical causes*)

- Dysgenesis (small testis).
- Short testicular artery.
- Short spermatic cord.
- Large testis.
- Band of adhesions.
- Associated hernial sac.
- Inadequate inguinal canal or rings.

⇒ **Bilateral causes** (*hormonal causes or bilateral mechanical*)

It may lead to **Cryptorchidism** → hypogonadism.

- Deficiency of **maternal** HCG
- Deficiency of **fetal** pituitary gonadotropin (testis not sensitive to gonadotropins).

- ▶ **Etiology:** mechanical, hormonal
- ▶ **Comp.:** TESTIS (Trauma, Epididymo-orchitis, Sterility, Torsion, Ing.hernia, Seminoma) + psychological
- ▶ **C/P:** mother: one or both sides are empty scrotum & testis aren't well developed
- ▶ **Invest.:** laparoscopy, radio (CT), lab.
- ▶ **TTT:** hormonal or orchiopexy

## Incidence

- 1% of all males and higher incidence in premature infants
- Side:
  - 50% **right side** (due to later descend of the right testis, So testicular tumors are more common on right side)
  - 30% left side.
  - 20% bilateral.
- Urinary tract anomalies in 13.5%.

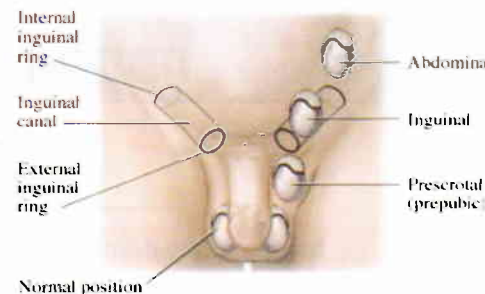
## Risk Factors

- The mother has a family history of unexplained newborn deaths or abnormal genitalia.
- The fetus has Down syndrome.
- The mother is younger than 20 or older than 35.
- The mother has been exposed to pesticides or other toxic chemicals.
- The mother is in poor health.

## Sites

⇒ **The sites of arrest:**

1. Intra-abdominal.
2. **Inguinal canal**.(most common site of arrest).
3. Superficial inguinal pouch (very rare): it must be differentiated from retractile testis which is more common.
4. At neck of scrotum



## Complications

1. **Psychological.**
2. Liability to **trauma & torsion** which may occur intra-uterine leading to vanishing testis (DD: strangulated hernia).
3. **Epididymo-orchitis** due to urinary tract anomalies e.g. stricture → UTI infection

4. **Sterility:** *In bilateral cases (cryptorchidism)*

- Due to injury of the **exocrine** function of the testis due to destruction & hyalinization of the seminiferous tubules.
- There is no effect on **endocrine** function (normal testosterone, normal 2ry sexual characters, erection, ejaculation "prostatic fluid" & no impotence but Azoospermia )
- This becomes irreversible destruction by the age of 16 years.

5. **Liability to malignancy (Seminoma)** *30 times* more than normal.

- This is due to dysgenetic testis (& may affect the patient even after a successful orchiopexy) so orchiopexy is done only for early detection of malignancy.

6. **Indirect inguinal hernia** is present in about 90% of cases & might be complicated.**Clinical Picture****Symptoms**

- **Mother** complains that one or both sides of her baby scrotum are empty.

**Signs**1. **The Scrotum:**

- Empty scrotum (unilateral or bilateral)
- **Poorly** developed scrotum.
- The median scrotal raphe is deviated towards the affected side.

2. **The Testis:**

- Usually present **in** the inguinal canal.
- It is **not well developed**.

3. **Associated other anomalies (hypospadias)****Why is the undescended testis difficult to feel?**

- Dysgenesis (small testis).
- Behind it fascia transversalis.
- In front of it the aponeurosis of external oblique muscle.

**DD**

1. Ectopic testis
2. Retractable testis.
3. Surgically removed testis.
4. Agenesis.
5. Hermaphroditism : should be excluded in bilateral cases

**Investigations**

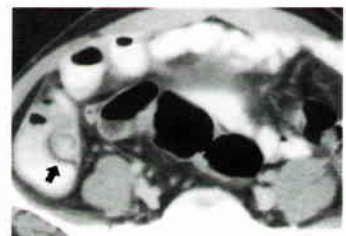
*The most important investigation is laparoscopy*

**Radiological**

1. **U/S & CT scan**
2. **IVP** for associated urinary anomalies

**Instrumental**

- **Laparoscopy** (the best).



C.T. of intra-abdominal testis



Laparoscopic view of intra-abdominal testis

## Laboratory

1. Karyotyping in the bilateral cases.
2. Hormonal assay (testosterone and LH ) to exclude cases of anorchia in bilateral cases

## Treatment (Surgery is the standard treatment)

### I. Treatment of incompletely descended testis:

#### Bilateral cases

##### ⇒ Hormonal therapy (success rate 10%)

- We might give **B-HCG 500 U I.M twice per week for 4 wks**

Never to give beta HCG for more than 6 weeks as testosterone secretion will occur.

- Never to give testosterone as it leads to short stature due to closure of epiphysis.

- In bilateral adult cases → no role for hormonal therapy because adult has full hormones.

##### ⇒ Orchiopexy:

- If hormonal therapy failed or adult case. Wait 6 months between the two sides.

#### Unilateral cases

- We do orchiopexy for the affected side.

##### ⇒ Orchiopexy

A. Under ideal circumstances orchiopexy should be performed between 6-24 months

B. Divide adhesions to elongate the cord

C. Methods of fixation

- Place the testicles in Dartos pouch created between skin and Dartos muscle (De Neto)

D. If there is short Cord → Dissect the cord to elongate it.

*If the cord is not long enough one of the following might be done:*

1. The testicular vessels can be divided & testis is mobilized on a pedicle containing the vas & the artery of the vas (Fowler-Stephen technique).
2. Autotransplantation using microvascular anastomosis between the distal end of testicular artery & the inferior epigastric vessels to add more blood supply to the testis.
3. *Two stage operation with interval 6 months.*

➡ In bilateral cases repair one side and the other side after 6 months

➡ Orchiectomy is done only if the other testes is normal and the undescended one is atrophic

### II. Repair of associated hernia (if present)

Patient with one testis removed and the other is short with no hope for descent???

#### ➔ Orchiocelioplasty

Abdominal replacement for preservation of hormonal functions & avoiding torsion

## B-Ectopic testis (Maldescended testis)

### Definition

- The testis has passed the external ring to an ectopic subcutaneous position

- **Etiology:** ruptured gubernaculum
- **Comp.:** trauma, torsion, psychological
- **C/P:** same mother  
Scrotum & testis are well developed
- **Invest.:** not needed
- **TTT:** orchiopexy (easier)

### Etiology

#### ⇒ Lockwood theory:

- Rupture of the gubernaculum so one of the accessory tails is in work.

### Sites

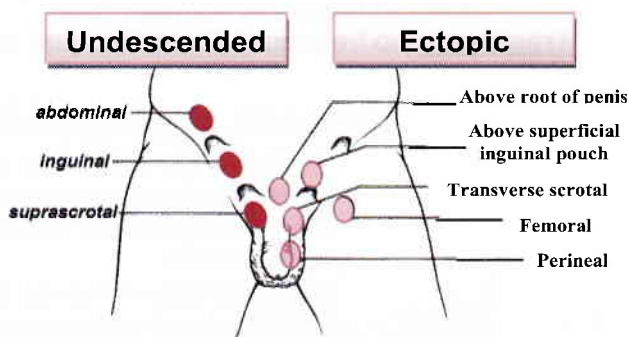
#### A. Around inguinal ligament:

- **Above:** superficial inguinal pouch. (most common)
- **Below:** femoral triangle.

#### B. Around penis:

- **Above** root of the penis.
- **Below** in perineum.

#### C. Transverse scrotal.



### Complications

1. **Psychological.**
2. Liability to **trauma & torsion** which may occur intra-uterine leading to vanishing testis (DD. strangulated hernia)

*NB. Normal spermatogenic & hormonal functions*

### Clinical Picture

#### Symptoms

- **Mother** complains that one or both sides of her baby scrotum are empty

#### Signs

##### 1- The Scrotum:

- Empty scrotum (unilateral or bilateral)
- Is well developed (normally, at the external ring the testis secretes hormones to develop the scrotal compartment of its same side.

##### 2- The Testis:

- It is **outside** the inguinal canal & during muscle contraction the testis becomes better felt.
- It is of **normal size**.

### DD

1. Arrested testis
2. Retractable testis.
3. Surgically removed testis.
4. Agenesis.

### Investigations

- No need for investigations as its site can be detected clinically.

### Treatment

- Orchiopexy is easier as the cord is usually long.



## C- Retractable Testis

Very mobile testis due to exaggerated cremasteric reflex it retracts with:

- Cold exposure.
- Scratch of the medial side of the thigh.

### It is diagnosed by

1. Scrotum is well developed.
2. The testis is of normal size.
3. Repeated examination in warm room.
4. Make the child squat this help the descend of retractile testis, which is milked down to touch the scrotum floor.

**Treatment:** no treatment is required just **reassurance**.

### Differential diagnosis of empty scrotal compartment

1. Retractable testis (the commonest)
2. Incompletely descended testis.
3. Mal descended testis.
4. Agenesis
5. Surgically removed testis.
6. Atrophied testis (vanishing testis)

## Traumatic diseases of the testis

### Torsion of the Testis

No torsion on top of normal testis

### Definition

- It is the most common pediatric urologic emergency, in which the testis there is rotation of the testis & epididymis around the axis of the spermatic cord blocking the blood supply of the testis.

- **Etiology:** inversion (most common)
- **C/P:** pain, swelling, tender testis, Elevation of the scrotum ↑ the pain
- **D.D.:** epididymo-orchitis
- **Invest.:** Doppler, Duplex, urine anal.
- **TTT:** bilat. orchiopexy or orchiectomy

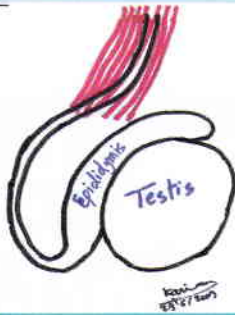
### Etiology

#### Predisposing Factors

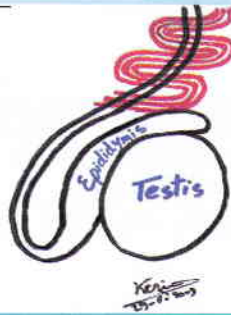
1. Inversion of the testis ( the most common)
  - Anterior Inversion (more common)
  - Polar inversion (epididymis on upper pole associated abnormal tunica vaginalis)
2. Imperfectly descended testis (incomplete or ectopic)
3. Long mesorchium.
4. High investment of the tunica vaginalis (Clapper in a bell effect).
5. Spirally attached cremasteric muscles.
6. **Separation of epididymis from body of testis → torsion around the pedicle between them.**



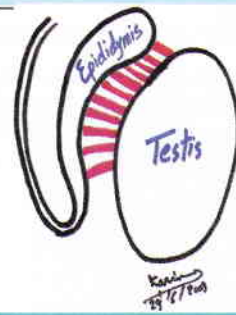




**Normal  
cremasteric M.**



**Spirally attached  
cremasteric M.**



**Long  
mesorchium**

## Precipitating Factors

- Straining or minor but spontaneous torsion may occur.

## Pathology

- The testis rotates from outside inwards.
- Gangrene occurs within 8-12 hours if the condition is not treated.

**Testicular  
torsion**



**Gangrenous  
testis on  
top of**



## Clinical Picture

*Infant or adult 15-25 years with sudden severe testicular pain.*

## Symptoms

- Pain** → sudden severe agonizing pain in scrotum & lower abdomen.
- Swelling** → Testicular swelling.
- Reflex symptoms** → Nausea, vomiting & collapse.

## Signs

⇒ **General:** pallor, sweating & tachycardia (up to shock).

⇒ **Local:**

### 1- Torsion of imperfectly descended testis:

- The scrotum is empty in the corresponding side.
- The inguinal canal is swollen, tender.

### 2- Torsion of the complete descended testis:

- The scrotum:**
  - Swollen, red & tender.
  - Dimple in site of gubernaculum.
  - Elevation of the scrotum ↑ the pain.
- The cord:** twist might be felt on the cord.
- The testis is:**
  - High up in position.
  - Tender & irreducible.
  - Small vaginal hydrocele.

*The cremasteric reflex is absent in the affected side.*

**DD** (Of acute scrotum)**I. Acute epididymo-orchitis:**

|                          | <b>Testicular torsion</b> | <b>Acute epididymo-orchitis</b> |
|--------------------------|---------------------------|---------------------------------|
| <b>Age</b>               | Adolescent & children     | Adult or elderly                |
| <b>History</b>           | Mild trauma               | UTI symptoms                    |
| <b>Temperature</b>       | Slightly elevated         | elevated                        |
| <b>Scrotal elevation</b> | ↑ pain                    | Partially relieves pain         |
| <b>Urine analysis</b>    | Free                      | Pus cells                       |
| <b>Doppler</b>           | Obstructed testicular Vs. | Patent Vs.                      |

**II. Strangulated inguinal hernia:** irreducible, no impulse on cough, tense & tender**III. Idiopathic scrotal edema:**

- Between 4-12 years.
- C/P → huge scrotal swelling that may extend to perineum, penis and groin with little pain and tenderness.
- Resolves within few days.
- Recurrent.

**IV. Torsion of a testicular appendage** which is hard to be differentiated from testicular torsion, the most common to be rotated is hydatid of morgagni.**Causes of Acute Scrotum**

- 1) Epididymis: epididymitis (acute epididymo-orchitis).
- 2) Testis: orchitis- Rupture testis.
- 3) Cord: funiculitis – torsion.
- 4) Tunica: pyocele – hematocele.
- 5) Torsion one of testicular appendages e.g. hydatid of Morgagni.

**Investigations**

- **Doppler & Duplex scan:** detect obstruction of blood flow in testicular vessels which ↑ in inflammatory state i.e. epididymo-orchitis
- **Urine analysis.**

**It's advisable to proceed directly to scrotal exploration to avoid testicular gangrene**

**Treatment**

1. **In 1<sup>st</sup> hour:** it may possible to untwist the testis by gentle manipulation.
2. **Correct general condition.**
3. **Urgent operation:**
  - a- In early cases:
    - Untwist the cord.
    - Orchiopexy to prevent recurrence.
    - Eversion of the tunica to prevent hydrocele formation.
  - b- In late cases (where the testis is gangrenous): orchiectomy
4. **Orchiopexy of the other testis:**
  - As the anatomical cause of the torsion is likely to be bilateral.
  - Fixation by non absorbable sutures between tunica vaginalis & tunica albuginea.



# Varicocele

## Definition

- It is varicosity (dilatation, elongation and tortuosity) of pampiniform & cremasteric plexuses of veins

## Primary Varicocele

## Incidence

- 15% of general population.

## Etiology

**Its exact cause is unknown**

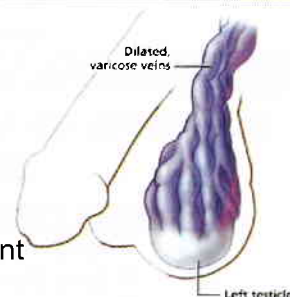
## Predisposing factors

- Age:** Between puberty and 35 years
- Congenital weak mesenchyme:**
  - Which might be associated with hernia & varicose veins, piles.

## Precipitating factors

- Increase venous pressure**
  - Prolonged standing.
  - Straining as in constipation.
  - Venous congestion due to unrelieved sexual excitement

- Incid.:** 15%, more on Lt. side
- Etiology:** cong. mesenchymal weakness
- C/P:** pain, bag of worms, thrill on cough, ↓ on lying down (1ry only)
- Comp.:** Subfertility, Thrombophlebitis, Secondary hydrocele, Testicular atrophy, neurosis
- Invest.:** Duplex, semen analysis
- TTT:** conservative, varicocelectomy



## Why primary varicocele more common on left side than right?

- Pelvic colon passes on the left testicular vein.
- The left testicular vein is longer than the right vein (i.e. more venous pressure)
- The left testicular vein opens at right angle in the left renal vein.
- Left suprarenal gland secretes adrenaline near the mouth of the left testicular vein
- The left common iliac vein is crossed by the right common iliac artery this causes higher pressure in the veins of the vas & cremasteric vein
- High pressure in the left renal vein as it is compressed between the superior mesenteric artery & aorta (nut cracker effect)
- The left testicular artery arches over the left renal vein in 16 % of cases.
- Valves at the end of the left testicular vein are usually malformed while on the right side are usually competent.

## Clinical Picture

## Symptoms

- Usually symptomless** and discovered at medical examination but it may present by:
  - Pain:** increase by prolonged standing or hot weather
    - Dragging pain:** due to relaxation of Dartos & cremasteric muscles.
    - Throbbing pain** in case of thrombophlebitis.
  - Swelling:** scrotal swelling.



## Signs

### ▪ General:

- Patient is usually tall & thin & visceroptosis may be present.

### ▪ Local:

#### - Inspection:

- Left side of the scrotum hangs lower than the right side.
- Scrotal skin may have dilated veins.

#### - Palpation

- Scrotal neck test fullness at the neck of the scrotum.
- Varicosity is felt as a bag of worms.
- Thrill on cough may be felt due to turbulence of blood flow.
- Swelling which disappears when patient lies down & scrotum is elevated.
- Small lax 2ry hydrocele → can be detected by pinching test.



To differentiate  
it from 2ry  
varicocele

## Complications

- 1. Subfertility** (20 % of cases) → due to ↓ motility of sperms ( asthenospermia)

### Why?

#### Thermal Theory:

- The temperature difference between scrotum & rectum has to be 2.5°C.
- If less this might impair spermatogenesis.
- Even if unilateral due to transmission of heat by contact with the other side.

### 2. Thrombosis → thrombophlebitis

### 3. Secondary hydrocele

- Due to chronic congestion of the testis.

### 4. Testicular atrophy!!! (very late)

- Chronic congestion → ↑ venous pressure → ↓ arterial blood supply → testicular atrophy.
- The testis becomes softer in consistency & smaller in size.

### 5. Neurosis

### DD

- Inguino-scrotal swelling.

## Grading

### A. Clinically detected varicocele:

- Grade I: present only with Valsalva.
- Grade II: present without Valsalva.
- Grade III: visible through the skin (bag of worms).

### B. Subclinical (not palpable): detected by Doppler reflux on Valsalva maneuver.

## Investigations

### Laboratory

- Semen analysis (for medico-legal importance) → **stress pattern**. (asthenospermia & oligospermia.)



## Radiological

- **Duplex scan** → detects reversed blood flow & bilaterality.
- **Scrotal or Transrectal U/S:**
  - Best test to evaluate the seminal vesicles and ejaculatory ducts.
  - Valuable in visualizing and grading varicocele.
- **Abdominal U/S** → to exclude 2ry varicocele e.g. hypernephroma.

## Treatment

### Conservative Treatment

(2 supports)

- 1- **Reassurance of the patient** as the condition is usually self limiting around the age of 40 years (**Psychological support**).
- 2- **Scrotal support** (may cause subfertility due to high temperature).
- 3- **Sedatives.**
- 4- **Avoid constipation**, pelvic congestion.
- 5- **Cold baths** to the scrotum.

### Operative Treatment

(Varicocelectomy)

- **Indications:**
  - Failure of medical treatment (Severe symptoms that can't be tolerated).
  - **Complications:**
    - 1- Subfertility.
    - 2- Recurrent thrombophlebitis
    - 3- Failure of medical commission.
    - 4- Neurotic patient.
- **Types:**

#### 1- Open surgery

#### A. Microscopic sub-inguinal approach (Mark Goldstein):

- The most commonly used approach.
- ❖ **Steps:**
  - Anterolateral incision in the scrotum.
  - The testis is delivered to isolate and divide gubernacular and external spermatic veins.
  - After testis is returned to the scrotum, spermatic cord is elevated with ligation of dilated testicular vein (under operating microscope).
- ❖ **Advantages:**
  - Direct approach to spermatic cord.
  - Small incision.
  - Less postoperative pain as there is no incision of aponeurosis.

#### B. Inguinal approach (Modified Ivanissevich and Gregorini):

- ❖ **Steps:**
  - Inguinal incision 5-10 cm.
  - The spermatic cord is exposed and dissected.
  - All dilated testicular vein are ligated.
  - The cord is elevated with ligation of cremasteric vein (running parallel to spermatic cord).
- ❖ **Advantages:**
  - Low incidence of varicocele recurrence.
- ❖ **Disadvantages**
  - Hydrocele formation (7%).
  - It weakens the inguinal canal and may lead to inguinal hernia.
  - Testicular artery injury.



**C. Retroperitoneal approach (Palomo):**❖ **Steps:**

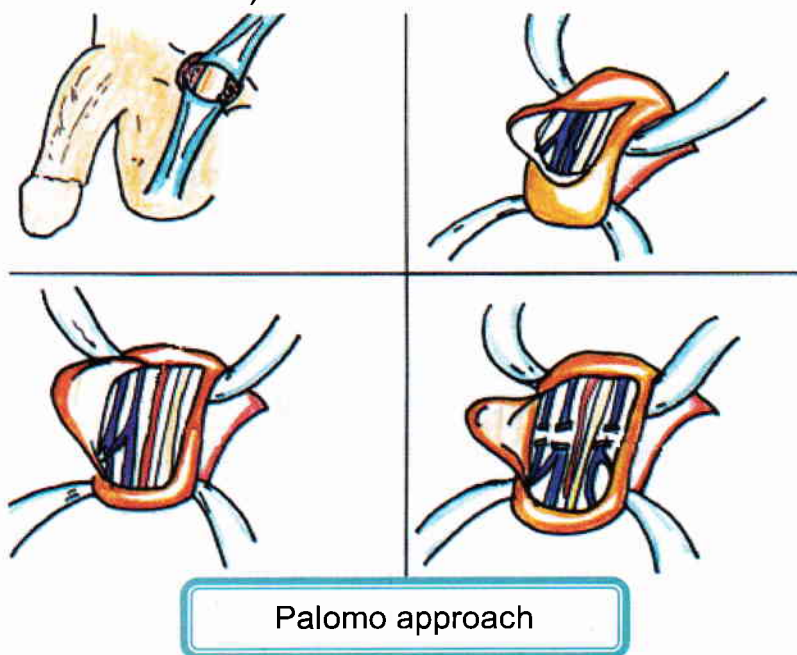
- Incision at the level of internal inguinal ring
- Splitting of muscles of anterior abdominal wall
- Exposure and ligation of testicular vein retro-peritoneal near the ureter

❖ **Advantages:**

- Testicular artery has not yet branches at this level, and is distinctly separated from internal spermatic vein
- Isolating the internal spermatic vein at the level where only one or two large veins are present.

❖ **Disadvantages:**

- **High incidence of recurrence** due to presence of collateral vessel that may bypass area of ligation.
- Injury of testicular artery and lymphatic (as they can not be delivered into the wound at this level)

**2- Laparoscopic varicocelectomy**❖ **Advantages:**

- Better convalescence.
- Minimal invasiveness.
- Less analgesics requirement post-operatively.

❖ **Recommended:**

- If there is need to concurrent laparoscopic procedure such as hernia repair.

**3- Percutaneous venous embolization**

- Performed with angiographic catheter under sedation

❖ **Route:**

- introduced via femoral or jugular veins, then advanced into spermatic veins

❖ **Materials used:**

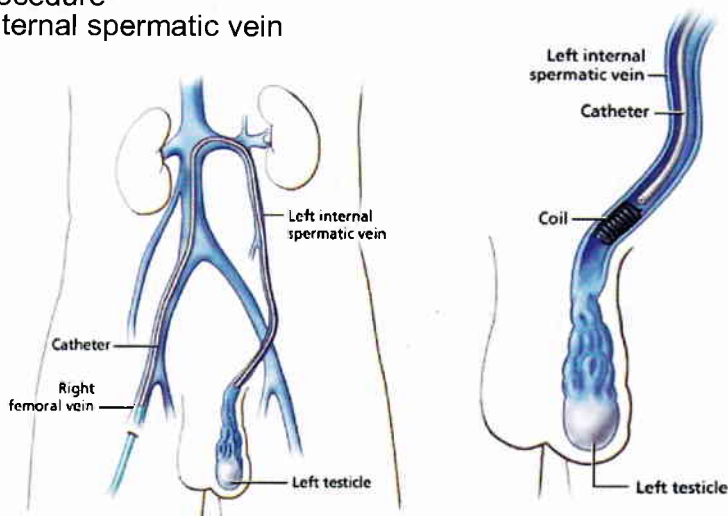
- Detachable balloon, coil, sclerosing materials or polymerizing tissue adhesives

❖ **Advantages:** no risk for hydrocele

- Very short post-operative recovery with minimal pain.
- **Technical success rate is high.**

❖ **Disadvantages:**

- Long duration of the procedure
- Failure to access the internal spermatic vein
- Radiation exposure
- Recurrent varicocele



## Oral Questions

### WHO grading (Clinical grading system)

|             | Visibility                | Mass of veins on Valsalva's manoeuvre |
|-------------|---------------------------|---------------------------------------|
| WHO Grade 1 | palpable but invisible    | < 1 cm                                |
| WHO Grade 2 | palpable and less visible | 1-2 cm                                |
| WHO Grade 3 | always visible            | >2 cm                                 |

### Doppler grading → used to grade venous reflux

**Grade I:** Static

**Grade II:** Intermittent

**Grade III:** Continuous

- The two grading system are not the same and they differ than each other i.e. WHO grade 1 ≠ Grade I

## Secondary Varicocele

### Causes

**It is due to venous obstruction.**

1. The commonest cause is **hypernephroma** (it spreads in the renal vein like finger in glove).
2. Retroperitoneal tumors.
3. Retroperitoneal fibrosis.

### It differs from primary type in

- 1- Older age group. (usually >40 years )
- 2- Rapidly progressive.
- 3- No thrill on cough.
- 4- Size is not reduced when patient lies down & scrotum is elevated.

# Hydrocele

## Definition

- It is collection of serous fluid inside a part or the processus vaginalis.

## Types

### A. hydrocele of tunica vaginalis:

- 1- Congenital.
- 2- Infantile.
- 3- Vaginal hydrocele (1ry or 2ry )

### B. Hydrocele of spermatic cord:

- 1- Encysted hydrocele of the cord
- 2- Diffuse hydrocele of the cord.
- 3- Hydrocele of hernial sac.

### C. Rare types:

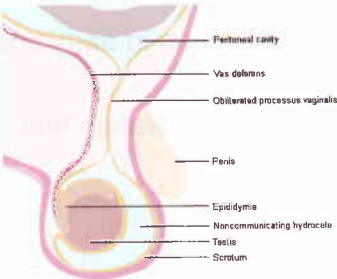
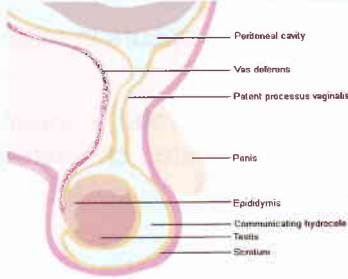
- 1- Hydrocele of canal of Nuck (in females lies).
- 2- Tyre hydrocele: recurrent after eversion.
- 3- Hydrocele en bisac: one below scrotal neck and one above.

## Etiology

- 1- Excessive fluid formation as in secondary hydrocele.
- 2- Spermatic cord lymphatic obstruction by filariasis or low grade infection.

## Complications

- 1- **Hernia of the hydrocele sac:** in long standing cases the sac might herniate through the Dartos muscles that may rupture.
- 2- **Hematocele.**
- 3- **Infection.**
- 4- **Rupture** usually traumatic but might be spontaneous
- 5- **Calcification.**
- 6- Bilateral huge cases might lead to **atrophy of the testis**. In unilateral cases → no atrophy as hydrocele distends in wide scrotum

| Infantile Hydrocele                                                                                                                                                                                                                                                                    | Congenital Hydrocele                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>Causes</b></p>                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p>The sac has no connection with the peritoneum</p>  <p>Labels: Peritoneal cavity, Vas deferens, Obliterated processus vaginalis, Penis, Epididymis, Noncommunicating hydrocele, Testis, Scrotum</p> | <ul style="list-style-type: none"> <li>• It is due to failure of the obliteration of the processus vaginalis.</li> <li>• It connects with the peritoneal cavity.</li> <li>• <b>Small opening</b> allow passage of fluid but not intestine.</li> <li>• It is either uni or bilateral</li> </ul>  <p>Labels: Peritoneal cavity, Vas deferens, Patent processus vaginalis, Penis, Epididymis, Communicating hydrocele, Testis, Scrotum</p> |
| <p style="text-align: center;"><b>Clinical Picture</b></p>                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>• Swelling.....</li> <li>• There is no fluctuation in size</li> </ul>                                                                                                                                                    | <p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>• Mother reports that the baby has a swelling in the scrotum.</li> <li>• There is <b>fluctuation in size</b> by day and night.</li> </ul>                                                                                                                                                                                                                                                                                                                   |
| <p style="text-align: center;"><b>Signs</b></p> <ul style="list-style-type: none"> <li>• Cystic, translucent inguinoscrotal swelling.</li> <li>• Not reducible manually.</li> </ul>                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p style="text-align: center;"><b>Treatment</b></p>                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p>❖ Eversion of the tunica <i>Infantile</i><br/>NB Hydrocele is not necessary to occur in infants</p>                                                                                                                                                                                 | <p>Conservative for 6 months waiting for spontaneous closure, if not excision of the upper part of the sac till the internal ring.</p>                                                                                                                                                                                                                                                                                                                                                                                    |

# Primary Vaginal Hydrocele

## Causes

Its cause is unknown . chronic congestion & irritation by repeated trauma and/or decrease fluid absorption by tunica are possible causes

- ▶ **Etiology:** unknown
- ▶ **C/P:** painless swelling (cystic, translucent, purely scrotal)
- ▶ **Invest.:** not needed (U/S if tense)
- ▶ **TTT:** Lord's op., excision, eversion

## Incidence

- Vaginal hydrocele occurs in middle aged male but not uncommon in early childhood

## The Fluid

- Thin Amber yellow water, contains albumin , fibrinogen in concentration that resembles transudate , cholesterol in old standing cases

## Clinical Picture

## Symptoms

- Painless swelling in one of the scrotal compartment (gradual onset, progressive course, long duration)

## Signs

- Inspection → Swelling in one scrotal compartment
- Palpation → non tender, cystic, translucent (by transillumination test) and purely scrotal swelling.
- No impulse on cough



## Investigations

- No investigations are needed as its clinical diagnosis, however if there's rapidly accumulating hydrocele, the patient should be investigated for malignancy.
- If hydrocele sac is tense → U/S scan to visualize the testis is necessary.

## Complications

See before

## Treatment

### 1. Lord's operation (plication of tunica vaginalis)

*Aims to make the fluids in contact with lymphatics of the scrotum.*

#### Steps

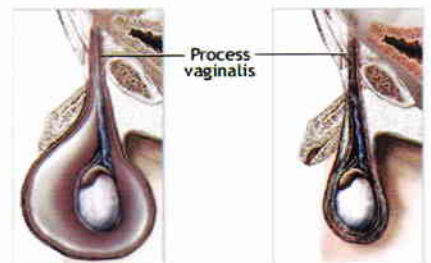
1. Antero-lateral incision is made in the scrotum.
2. The tunica is opened.
3. The fluids are evacuated.
4. The tunica is plicated.
5. Tunica is not removed to avoid hemorrhage.
6. Drain is inserted



### 2. Subtotal excision of the tunica vaginalis:

*It is done in cases of:*

- 1- Calcified tunica.
- 2- Loculated hydrocele.
- 3- Recurrent hydrocele after eversion of tunica



### 3. Eversion:

Suitable for small hydrocele but may be complicated by recurrence.

**Aspiration is not used except in high risk bad general condition patient as aspiration might leads to hematocele , pyocele, recurrence or injury of the testis**



## Other rare types of Hydrocele

### Secondary Vaginal Hydrocele

#### Causes

- Disease in testis, cord, epididymis or postoperative after repair of hernia.
- It is usually lax & rarely attains large size except in malignancy.
- If there is possibility to be with testicular tumor U/S, pregnancy test, alpha feto protein or even exploration and frozen section is done.

### Encysted Hydrocele of the Cord

#### Causes

- Failure of obliteration of the middle portion of the processus vaginalis.
- It becomes distended with fluids

#### Clinical Picture

#### Symptoms

- Child or adult with painless swelling in the scrotal compartment.

#### Signs

- Cystic, painless, translucent swelling.
- It is scrotal swelling.
- Separated from the testis by interval.
- **It is mobile across the cord.**
- **Its mobility is restricted on downward traction of the testis. (traction test )**

#### Treatment

- **Excision**

### Diffuse Hydrocele of the Cord

- Due to chronic lymphatic obstruction , usually due to filariasis
- 80% of cases in tropical countries.
- In many cases there is no history of filariasis.

#### Pathology

- Acquired obstruction of cord lymphatics by filaria → lymphangiectasis → lymphocele or chylocele

#### Clinical Picture

- Lymphocele is cystic, translucent, irreducible, soft, dull, diffuse inguinoscrotal swelling with no expansile impulse on cough
- Funiculitis is common as the cord is thick & matted.
- The presence of chyle proves the filarial origin.
- Hydrocele is commonly bilateral

### Hydrocele of Hernial Sac

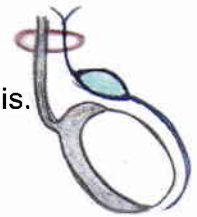
- Occurs in narrow necked sac if contents return to abdomen and neck becomes occluded by omentum allowing serous fluid to collect in the sac

### Hydrocele of Canal of Nuck

- equal processus vaginalis in male
- **In female...cyst in relation to round ligament**
- it is always or partially in the inguinal canal
- it equals encysted hydrocele of the cord in female

### Hydrocele en Bisac

- ❖ **2 communicating sacs**
  - One below scrotal neck.
  - One above scrotal neck.



# Hematocele

## Etiology

- Trauma
- Tapping of hydrocele (commonest).
- Generalized bleeding disorders.
- Torsion

## Complaint

- Swelling which is Tender, Bluish.

## Fate

- 1- Absorbing is slowly & uncertain.
- 2- Clotted hematocele.
- 3- Infection.
- 4- Calcification.



## Treatment

Exploration, evacuation, eversion of the tunica + cauterize the bleeder, & check out the testis for trauma or laceration.

- Old clotted hematocele may simulate testicular tumor.
- So we have to evacuate the hematoma.
- Explore the testis if possible.
- Remove the testis for any doubt as it is usually compressed & not functioning

### If there is injuries of the testis

- Evacuate the hematoma.
- Repair of tunica albuginea with excision of the prolapsed parts of the tissues.
- Removal of the testis if severely damaged as this will lead to production of antibody and destruction of other testis as sperms are sequestered antigen.

# Testicular Neoplasm

## Definition

Abnormal rapid and invasive growth of malignant cells in the testis.

## Incidence

- 99 % of testicular neoplasms are malignant
- 1-2% of malignant tumors in male.
- The commonest cancer in young men (15-40 years old).
- more common in Right side due to ↑ incidence of maldescent

- **Types:** seminoma 40%, teratoma 32%
- **C/P:** swelling, pain(late), lost sensation
- **Invest.:** diag.(U/S, markers, biopsy), staging, pre-op.
- **TTT:** orchiectomy + chemo ± radio

## Classification

### A. Germ cell tumors:

- Seminomas 40 %.
- Teratoma 32 %.
- Seminoma + Teratoma 14 %.

*Main types*

### B. Interstitial tumors 1.5 %

- Leyding cell tumor.
- Sertoli cell tumor.

*Rare types*

### C. Secondary tumors

- Lymphoma 7%.
- Leukemic infiltration of the testis.
- Metastatic tumors.

| Seminoma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Teratoma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Age</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 30 – 50 years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 - 35 years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Origin</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Seminiferous tubules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Totipotent cells which have trigeminal potentiality.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Risk factors of germ cell tumor</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>- Undescended testis especially intra-abdominal varities. The incidence of malignancy in undescended testis is 15 times more than normal population</li> <li>- Positive family history.</li> <li>- Testicular dysgenesis e.g. Klinefelter syndrome</li> <li>- HIV infection</li> <li>- Genetics: 80% of these tumors have a specific marker chromosome called isochromosome 12 p</li> </ul>                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Pathology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p>❖ <b>Macroscopic picture:</b></p> <ul style="list-style-type: none"> <li>• <b>Large</b>, firm &amp; smooth</li> </ul> <p><b>Cut section:</b></p> <ul style="list-style-type: none"> <li>• <b>Homogenous</b> &amp; creamy or <b>pink</b> in color.</li> <li>• Fibrous Septa divide the mass into lobules.</li> <li>• Areas of hemorrhage and necrosis</li> </ul>  <p><b>Cut section Seminoma</b></p> | <p>❖ <b>Macroscopic picture:</b></p> <ul style="list-style-type: none"> <li>• Variable size, variable consistency and irregular surface.</li> </ul> <p><b>Cut section:</b></p> <ul style="list-style-type: none"> <li>• Heterogenous &amp; yellowish</li> <li>• Areas of hemorrhage and necrosis</li> </ul> <p><b>NB.</b> Teratoma is surrounded by tunica albuginea → so shape of testis is preserved.</p>  <p><b>Cut section Teratoma (MTI)</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p>❖ <b>Microscopically</b></p> <p><b>Cells.</b></p> <ul style="list-style-type: none"> <li>• Rounded cells with large rounded nuclei.</li> <li>• Arranged in sheets separated by fibrous stroma.</li> <li>• Tumor is infiltrated by lymphocytes (good host reaction → good prognosis)</li> </ul>                                                                                                                                                                                        | <p>❖ <b>Microscopically:</b></p> <ol style="list-style-type: none"> <li>1. <b>Teratoma differentiated</b> (Dermoid cyst) <ul style="list-style-type: none"> <li>- Cyst is lined with stratified squamous epithelium and may contain hair bone, muscles as well as glandular element.</li> </ul> </li> <li>2. <b>Malignant teratoma intermediate (<u>The commonest type</u>)</b> MTI <ul style="list-style-type: none"> <li>- Is formed of cystic spaces filled with gelatinous substance.</li> <li>- Sub types A and B.</li> </ul> </li> <li>3. <b>Malignant Teratoma Anaplastic:</b> <ul style="list-style-type: none"> <li>- Composed of anaplastic cell.</li> <li>- Cells derived from yolk sac produced increased level of alpha-feto protein</li> </ul> </li> <li>4. <b>Malignant teratoma tropho-blastica (choriocarcinoma)</b> <ul style="list-style-type: none"> <li>- Malignant villous or papillary cyto-trophoblast produces HCG and spread early by blood and lymph.</li> <li>- <b>Most malignant testicular tumor</b></li> </ul> </li> </ol> |

## Staging

- **Stage I** → tumor is confined to the testis.
- **Stage II** → involvement of LNs below the diaphragm.
- **Stage III** → involvement of LNs above the diaphragm.
- **Stage IV** → distant metastasis.

## Spread

- **Local**
    - Spermatic cord, epididymis, scrotal wall.
  - **Lymphatic**
    - **Para-aortic lymph nodes** → thoracic duct → Virchow's gland (Troisier sign).
  - **Blood (rare)**
    - Where lungs are the first site
- NB: If there is invasion of the scrotum the inguinal LNs will be affected.*

**Mainly lymphatic spread**

**Mainly blood spread**

## Markers

- B-HCG & LDH (Radio-sensitive)

- B-HCG & α-feto-protein (Chemo-sensitive)

## Clinical Picture

**Middle aged male patient with testicular mass either discovered accidentally or after trauma as trauma arouses patient attention to mass**

## Symptoms

- May be **asymptomatic**.
- Painless testicular **swelling** (Gradual onset, progressive course).
- Sense of heaviness (when testis enlarged 2 or 3 times).
- **Pain** in advanced cases or in case of acute hemorrhage within the neoplasm.
- Symptoms of metastasis for example bone pain.
- Gynecomastia can occur in advanced stages of teratoma.
- Past history of undescended testis can be given.

## Signs

### 1- **Local:**

- **Testis is:**
  - Enlarged.
  - Hard, Heavy mass → later on areas of softening may be present
  - May be fixed to surrounding structures in advanced cases.
- Early loss of testicular sensation. (occur in syphilis & seminoma)
- Secondary hydrocele (rapidly accumulating).
- Thickening of spermatic cord and obliteration of epididymal sinus may occur late.

### 2- **Abdominal:**

- Para-aortic LNs enlargement.
- Liver enlargement.



**3- General:**

- Manifestation of metastasis for example pleural effusion, enlarged supraclavicular LNs.

- Any rapidly accumulating vaginal hydrocele should be investigated for tumors
- Inguinal LNs are only affected on infiltration of scrotal skin
- The clinical course of the tumor may be very slow as dermoid cyst or very aggressive as hurricane type which kills the patient within 1-2 years, however testicular neoplasms may be presented with picture like acute epididymo-orchitis.
- Abdominal mass with an empty scrotal compartment should rise suspicion of malignant transformation in abdominal undescended testis

**DD*****Of testicular mass with loss of testicular sensation.***

1. Syphilis (gumma).
2. Old clotted hematocele.

**Investigations****For diagnosis****1. Radiological:**

- **Scrotal U/S:** shows testicular mass and calcification (is more frequent with seminoma).

**2. Laboratory:**

⇒ **Tumor markers: (used also for follow-up)**

- **Beta HCG by Aschheim - Zondek test (pregnancy test):** it is raised in teratoma & occasionally in seminoma
- **Alpha fetoproteins**
  - Raised in teratoma.
  - Never raised in Seminoma alone.
  - May be raised in seminoma teratoma which is diagnosed by histopathology.
- **Serum LDH (isoenzyme 1):** elevated in 60% of cases.

**3. Instrumental:****1. No FNABC is done for testicular tumors:**

- The lymph drainage of the scrotum differs from that of the testis so, don't open new channel.

**2. Frozen section biopsy****Indications:**

1. When clinical diagnosis is doubtful.
2. When the markers are negative.

**Procedure:**

1. Inguinal incision.
2. Put vascular clamp on the cord at internal ring to prevent dissemination.
3. The testis is delivered.
4. A biopsy is taken and frozen section is performed.

**For staging**

- **Bone scan, CT scan, liver U/S, CXR.**
- **IVP:** distortion of the ureteric course which may indicate para- aortic LN metastasis.

**For preoperative preparation**

- **CBC, blood sugar, ECG, urine analysis....**



## Treatment

**A- Initial treatment** is by high inguinal simple orchiectomy

**B- Further management** depends on type & stage of the disease

### Seminoma (radio- & chemo-sensitive)

- **Stage I** → Radio-therapy to **para-aortic L.N.**  
(With protection of kidneys & other testis).
- **Stage II** → Radio-therapy is extended to **mediastinum**
- **Stage III** → chemo-therapy (cisplatin) +/- radiotherapy
- **Stage IV** → Chemo-therapy

### Teratoma (radio-resistance)

- **Stage I** → repeated assessment of serum markers and CT
- **Stage II-IV** → Combination chemo-therapy  
(Cisplatin, methotrexate, bleomycin & vincristine)

Retroperitoneal LNs dissection may be recommended with the initial treatment if there is no distant metastasis.

No radical surgery as removal of para-aortic LN carries high morbidity & mortality

Following surgery, follow up of patient with tumor markers must be done

## Prognosis

5 year survival

|                 | Stage I & II | Stage III & IV |
|-----------------|--------------|----------------|
| <b>Seminoma</b> | 95 %         | 75 %           |
| <b>Teratoma</b> | 85 %         | 65 %           |

## Interstitial Cell Tumor

### Leydig cell tumor (prepubertal tumor)

- It leads to masculinization of the patient (**infant Hercules** i.e. **precocious puberty**).

### Sertoli cell tumor (post pubertal tumor)

- It leads to feminization of the patient (loss of frontal recess, silky hair, change in body contour, gynecomastia, loss of libido and aspermia ).
- Orchiectomy is curative in both types.
- Pregnancy test is +ve

## More details

### TNM staging

#### 1. Primary tumor staging

- **Tis** - Intratubular germ cell neoplasia (carcinoma in situ)
- **T1** - Tumor limited to testis/epididymis without vascular or lymphatic invasion; tumor may invade into the tunica albuginea but not the tunica vaginalis
- **T2** - Tumor limited to testis/epididymis with vascular or lymphatic invasion or tumor extending through tunica albuginea with involvement of the tunica vaginalis
- **T3** - Tumor invading spermatic cord with or without vascular/lymphatic invasion
- **T4** - Tumor invading scrotum with or without vascular/lymphatic invasion

#### 2. Regional lymph node staging

- **N0** - No regional lymph node metastasis
- **N1** - Metastasis with lymph node(s) 2 cm or less in greatest dimension or multiple lymph nodes < 2 cm in greatest dimension
- **N2** - Metastasis with lymph node(s) > 2 cm but not < 5 cm in greatest dimension, or multiple lymph nodes, any 1 mass >2 cm, but < 5 cm in greatest dimension
- **N3** - Metastasis with lymph node(s) > 5 cm in greatest dimension

#### 3. Distant metastatic staging

- **M0** - No distant metastasis
- **M1a** - No regional nodal or pulmonary metastasis
- **M1b** - Distant metastasis other than M1a

## Diseases of the Epididymis

### Acute Epididymo-orchitis

#### Causative Organisms

- E.coli, Staph, Strepto, Gonococci.
- The commonest sexually transmitted infection causing epididymitis is now chlamydia

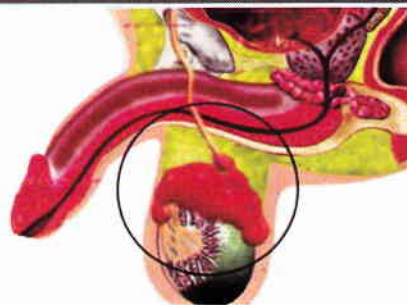
#### Route of Infection

- 1- Along the vas.
- 2- Peri-vasal Lymphatics.
- 3- Via blood stream.

#### Predisposing Factors

- **UTI**
  1. Cystitis.
  2. Catheterization.
  3. During the third week of Gonococcal urethritis.
- 18% of males infected with mumps develops acute epididymo-orchitis.

- ▶ **Etiology:** UTI, STDs
- ▶ **C/P:** FAHM, pain, swelling, tenderness
- ▶ **D.D.:** testicular torsion
- ▶ **Comp.:** chronicity, abscess, atrophy
- ▶ **Invest.:** urine an., C&S, Duplex
- ▶ **TTT:** AAA + drainage if abscess



## Clinical Picture

### Symptoms

- **Of the cause:** for example → dysuria
- **General:** FAHM.
- **Local:** Acute **painful** scrotal **swelling**, relieved by elevating scrotum.

### Signs

- **General:** temperature 39° C
- **Local:**
  - Scrotal skin is **red & edematous**.
  - Enlarged **tender** epididymis.
  - Secondary hydrocele.
  - Signs of **pus loculus** if abscess is formed.

### DD

#### (Testicular torsion)

- More in children & adolescent following mild trauma.
- O/E → Testis is swollen, tender & *higher than normal*.
- Twist may be felt on the cord.
- Elevation of the scrotum increases pain.
- Doppler → Obstructed testicular vessels.

## Complications

- 1- Testicular abscess
- 2- Testicular atrophy
- 3- Chronicity

## Investigations

- 1- **Urine analysis** + culture & sensitivity
- 2- **Duplex** (to exclude testicular torsion).

## Treatment

- 1- **Prophylactic:**
  - proper treatment of UTI
- 2- **Curative:**
  - Antibiotics, analgesics & antipyretics.
  - Rest of the affected organ (elevation of the scrotum).
  - If an abscess formed = drainage.
  - Doxycycline (100mg) is the treatment of choice in Chlamydia infection.

# Chronic Epididymo-orchitis

## Chronic Non Specific Epididymitis

### Causes

1. Bad General condition of the patient.
2. Inadequate treatment of acute abscess.
3. Persistence of predisposing Factors (i.e. urinary tract infection)

### Clinical picture

The epididymis is enlarged & tender.

### Treatment

- 1- Treatment of the cause.
- 2- Antibiotic according to culture.

*Inflammation is the response of the living tissue to irritant whether chemical, physical, or microbiological*

## TB Epididymitis

### Route of Spread

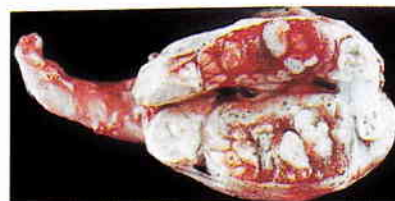
- It is usually secondary to urinary TB (lymphatic borne through the peri vasal lymphatics).
- Blood borne
- It is usually unilateral.

- ▶ Lymphatic borne, blood borne
- ▶ **C/P:** TB toxemia, urinary TB
- ▶ **Invest.:** urine an., culture, IVU
- ▶ **TTT:** sanatorial, anti-TB drugs

### Pathology

- **If lymphatic borne:**
  - The tail is affected at first.
  - The **vas is thick & beaded** with tuberculous nodules.
- **In blood born:**
  - The head affected at first.
  - The vas remains unaffected.
- **Later on:**
  - All the epididymis is enlarged, firm surface.
  - Breakdown occurs & caseous material comes out of multiple discharging sinuses posteriorly.
  - Small lax hydrocele.
- **Microscopically:** central caseation, Langerhans giant cell, epithelioid cells, fibrocytes

- Tail = Globus Minor
- Head = Globus Major



### Clinical Picture

#### Symptoms

1. Symptoms of TB toxemia.
2. Symptoms of urinary TB (see nephrology).

#### Signs

1. Signs of TB toxemia.
2. Epididymis is enlarged, firm with multiple sinuses discharging caseous material posteriorly.
3. DRE → TB nodules in the prostate and seminal vesicles.
4. Signs of urinary TB.
5. Vas is beaded

### Investigations

- 1- Urine analysis → sterile pyuria.
- 2- IVU → to detect urinary TB.
- 3- Culture of secondary on Lowenstein jensen media

### Treatment

- 1- Improve the general condition (**Sanatorial treatment**).
- 2- **Anti - tuberculous drugs.**
  - If no response after 2 months:
    - We do epididymovasectomy.
    - Anti-tuberculous drugs are given for another 4-6 months.



|                    |                       | TB mass                                                                                                                                                                                                             | Bilharzial mass                                                                                                                                                                                                         | Filarial mass (endemic funiculitis)                                                                |
|--------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Route of Infection |                       | <ul style="list-style-type: none"> <li>- Blood born (rare).</li> <li>- Lymphatic born from the urinary tract → through the vas.</li> </ul>                                                                          | Worms reach the pampiniform plexus through 2 routes: <ul style="list-style-type: none"> <li>- Vesicoprostatic plexus of veins.</li> <li>- S.M. → through anastomosis bet. The mesenteric &amp; spermatic vs.</li> </ul> | Through lymphatic.                                                                                 |
|                    | <b>Commonest site</b> | <ul style="list-style-type: none"> <li>- If lymphatic born the tail of the epididymis is involved then the whole of it.</li> <li>- If blood borne it affects the head at first then the whole epididymis</li> </ul> | <i>cord → peri-vascular affection</i> <ul style="list-style-type: none"> <li>- Granular type.</li> <li>- Nodular type.</li> </ul>                                                                                       | - All the cord became thick and matted                                                             |
| Clinical Picture   | <b>History</b>        | Of TB urinary tract.                                                                                                                                                                                                | Of bilharziasis                                                                                                                                                                                                         | Of an acute attack in an endemic area                                                              |
|                    | <b>Examination</b>    |                                                                                                                                                                                                                     |                                                                                                                                                                                                                         |                                                                                                    |
|                    | The cord.             | Affects the vas only (thickened & beaded in lymphatic borne).                                                                                                                                                       | <ul style="list-style-type: none"> <li>- Vas is intact</li> <li>- Beading of veins.</li> </ul>                                                                                                                          | Affect both the vas & the vessel, they are tender, swollen, & matted that you can't identify both. |
|                    | Epididymis.           | Nodular & swollen.                                                                                                                                                                                                  | Fine nodules & not tender.                                                                                                                                                                                              | Swollen & tender                                                                                   |
|                    | Testis.               | It affected late. Or never                                                                                                                                                                                          | Never                                                                                                                                                                                                                   |                                                                                                    |
|                    | 2ry hydrocele.        | Small lax hydrocele.                                                                                                                                                                                                | Moderate.                                                                                                                                                                                                               | Large hydrocele                                                                                    |
|                    | DRE                   | T.B. nodule in the seminal vesicles & prostate.                                                                                                                                                                     | Chronic fibrotic prostatitis.                                                                                                                                                                                           | Free.                                                                                              |
| Treatment          |                       | <ul style="list-style-type: none"> <li>- Medical Antituberculous.</li> <li>- Surgical, if failed medical do Epididymo-vasectomy.</li> </ul>                                                                         | - Medical.                                                                                                                                                                                                              | - Medical only Antibiotics & Hetrazan.                                                             |



## Cysts of the Epididymis

### Spermatocele

➤ **Definition:**

- It is a retention cyst of the vasa efferentia.
- It containing living, dead sperms.
- Fluid rich in cholesterol.
- It contains Barley water fluids

➤ **Symptoms:**

- The patients usually complain of swelling in the scrotum (that he has a third testis).

➤ **Signs:**

- Painless cystic swelling at the upper pole of the testis.
- Not separated from the testis by interval. ( to differentiate it from encysted hydrocele of the cord ).
- The main difference from vaginal hydrocele is that an epididymal cyst is felt separate from testis

➤ **Treatment:**

- Excision for fear of complications.

### Simple Cysts of the Epididymis

- It is related to vestigial structure (hydatid of Morgagni).
- It contains crystal clear fluid, no sperms.
- It may give multiple transillumination (Chinese lantern appearance).

Treatment    **Excision only if causing complications.**

## Diseases of Cord

- TB of the cord: vas is beaded if lymphatic born.
- Bilharziasis of the cord: veins are beaded (site of ovum deposition → fibrosis & granulation tissue formation).
- Fibrosis of the cord : lymphedema of the cord . Cord is thick and matted.

## D.D. of Scrotal Swellings

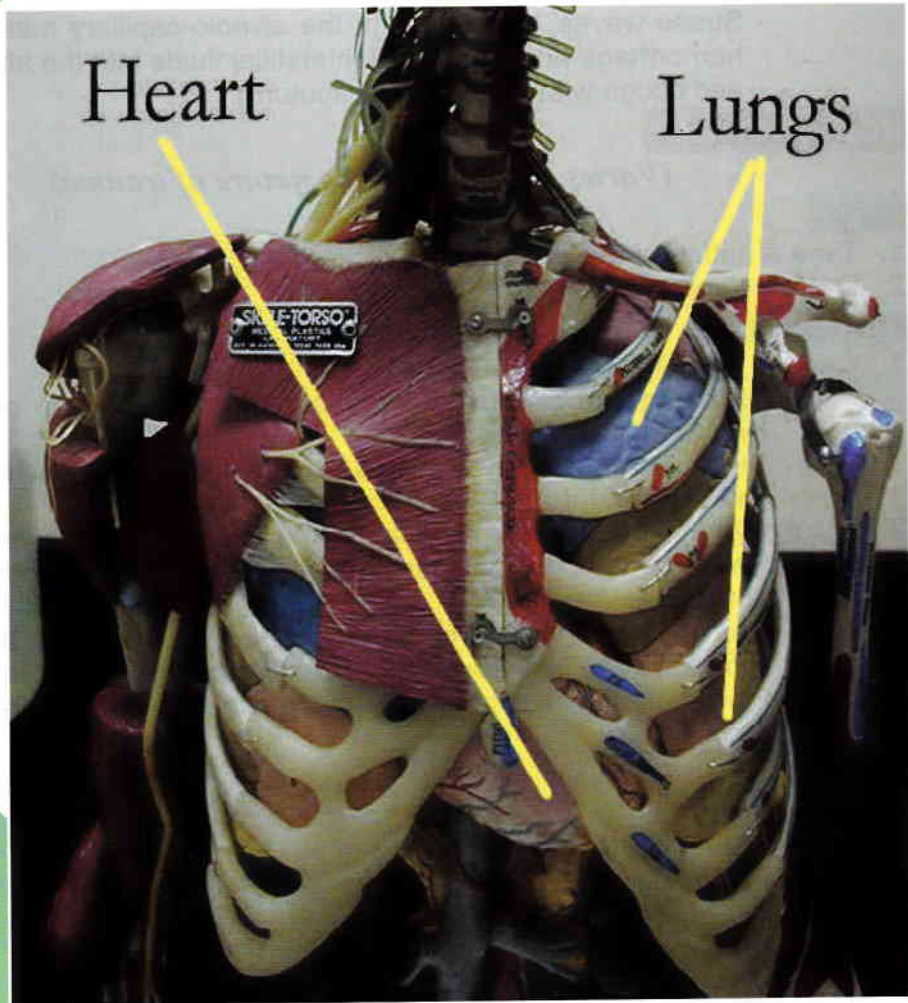
➡ **See differential diagnosis book**

## Acute Scrotum

➡ **See differential diagnosis book**

# CHAPTER

# 5



# CARDIOTHORACIC SURGERY

# Trauma to the chest

## Types of trauma

- A- Blunt trauma:** non-penetrating, such as car accidents (pleura may be intact).
- B- Penetrating trauma:** (pleura is injured)
  - Sucking wound.
  - Valvular wound.
- C- Blasts:** (part of chest wall may be lost)
  - Stress waves, which disrupt the alveolo-capillary membrane resulting in hemorrhage and leakage of interstitial fluids into the alveoli (C/O dyspnea and cough with frothy bloody sputum).

## Clinical picture

*(Varies according to the nature of trauma)*

## History

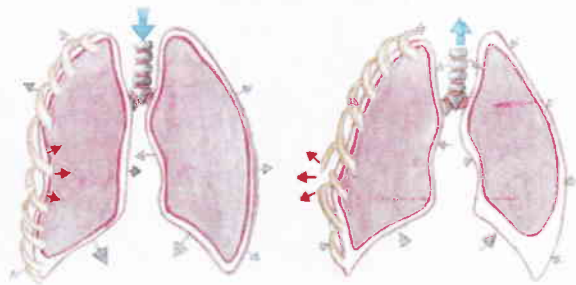
1. Time & nature of the accident.
2. Dyspnea and chest pain.

## Examination

1. General examination:
  - a- **Signs of shock** may be present: pallor, ↓ blood pressure, ↑ pulse, hypothermia etc...
  - b- **Signs of respiratory distress** may be present: cyanosis, working ala nasi.
  - c- **Associated injuries:** hepatic or splenic rupture.
2. Local examination: **bruises & ecchymosis** + one of the followings
  - a- Pneumothorax → mediastinal shift, ↓ TVF, **Hyper-resonant** note, ↓ air entry.
  - b- Hemothorax → shifted mediastinum, ↓ TVF, **dullness**, ↓ air entry.
  - c- Rib fracture → localized tenderness & crepitus at the site of fracture.
  - d- Flail chest → flail segment will move in a **paradoxical** way to the rest of the chest wall.

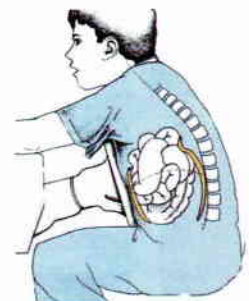
## Investigations

- a- Laboratory:
  1. ABG ( $PO_2$ ,  $PCO_2$ ).
  2. Blood sugar.
  3. KFTs.
- b- Radiological:
  1. Plain CXR.
  2. CT scan.
- c- Instrumental:
  1. Bronchoscopy (if tracheobronchial injury is suspected).
  2. Esophagoscopy (to exclude esophageal injuries).



## Complications of chest injuries

- 1- Chest wall: fracture rib and flail chest.
- 2- Pleura: pneumothorax and hemothorax.
- 3- Diaphragmatic injury.
- 4- Great vessel injury.
- 5- Cardiac injury.
- 6- Lung lacerations.
- 7- Esophageal injury.



**Blunt trauma may lead to diaphragmatic rupture**



## Treatment of chest injuries

### First aid for chest injuries

1. **Airway:** maintaining upper airways clear, even by insertion of cannula 14F in the cricothyroid membrane.
2. **Breathing:** keeping normal breathing rate by assisted or mouth to mouth breathing with observation of chest movement, the following problems may be present:
  - a- Flail chest → immobilization by strapping.
  - b- Sucking wound → should be sealed.
  - c- Tension pneumothorax → decompression by insertion of a wide-bore cannula in the 2<sup>nd</sup> intercostal space in MCL.
  - d- Penetrating objects → should be fixed (do not remove).
3. **Circulation:** precordial thump (once), external compression (cardiac massage), control of bleeding by compression (better than tourniquet, which may lead to distal ischemia).
4. **D** → **Damaged limb** → should be splinted.  
       → **Drugs** → morphine, if needed.

### At hospital

#### 1- Resuscitation & primary survey:

- a. Patient kept in semi-sitting (Fowler) position except if the patient is pulseless, he/she should be kept in Trendelenburg position.
- b. Maintain lower airway patency by endotracheal tube if needed.
- c. I.V line supplies the fluid according to patient's need.
- d. Oxygen therapy if needed.
- e. Drugs: antibiotics, analgesics & antiplatelet drugs.
- f. X-ray: upright position if possible.

#### 2- Continuous monitoring of:

- a. Level of consciousness.
- b. Vital signs (pulse, BP, temperature, and RR).
- c. Neck veins, CVP.
- d. Urine output, fluid chart and amount of drained fluid.

#### 3- Secondary survey:

- After establishment of general condition of the patient 2<sup>ry</sup> survey has to be done.

### Specific treatment

Life threatening conditions

1. **Pneumothorax:** insertion of intercostal tube under water seal in the 2<sup>nd</sup> space at MCL.
2. **Hemothorax:** aspiration or intercostal tube with underwater seal.
3. **Rib fracture:** adhesive strapping.
4. **Flail chest:** emergency strapping followed by fixation.

- Emergency thoracotomy may be required if there is uncontrollable internal or external bleeding.
- In serious chest injuries, it is necessary to admit the patient to the ICU where an endotracheal tube is inserted → allow effective and repeated aspiration of the tracheobronchial tree. If the patient is hypoxic or has flail chest, the endotracheal tube should be combined with intermittent positive pressure respiration.
- Sudden death if occurs it means error of the responsible doctor.
- Upper abdominal rigidity may be present in thoracic injuries not only in abdominal lesions.
- There is frequent hepatic & splenic rupture in lower chest injuries.

# Mediastinal injuries

## Types

### Closed injury

Abrasions or bruises.

### Open Injury

**Non-penetrating wound** → pleura is intact.

**Penetrating wound** → pleura is opened. ***It may be:***

- 1) **Sucking wound** → communicating the pleural space with the exterior → open pneumothorax.
- 2) **Valvular wound** → Allow air to enter the pleura but does not allow it to come out → tension pneumothorax.
- 3) **Extensive wound** with lacerations & loss of a part of the chest wall.

## Site

### Esophagus

- Hematemesis
  - Retrosternal pain
  - Mediastinitis
- } **TTT:** Urgent thoracotomy & repair

### Mediastinal pleura & lungs

- Mediastinal emphysema, mediastinitis → severe dyspnea & chest pain.

### Thoracic duct

- Chylous effusion.
- **TTT:** repeated aspiration & low fat diet.

### Heart & great vessels

#### ▪ Heart:

- Progressive hemothorax.
- Fatal hemorrhage (atrial hemorrhage).
- Cardiac tamponade:

Beck's  
Triad

- Shock (tachycardia, hypotension).
- Engorged neck veins.
- Distant heart sounds.
- Cardiac dullness is enlarged.
- **X-ray** → globular heart.
- **TTT:** urgent aspiration → thoracotomy → evacuate the pericardial hematoma then repair the ventricle.

#### ▪ Great vessels:

- Mediastinal hematoma.
- Hemothorax.
- Fatal hemorrhage.
- **TTT:** urgent thoracotomy & repair the vessels.



# Pneumothorax

## Definition

- Presence of air within the pleural cavity.

## Etiological types

### Traumatic

- **Accidental:**
  - Blunt injuries → fracture rib → injury of the pleura.
  - Penetrating injuries.
- **Iatrogenic:**
  - Barotrauma due to positive pressure mechanical ventilation.
  - Insertion of a central venous line in the neck (especially subclavian vein).
  - CT guided lung biopsy.

### Spontaneous

- **1<sup>ry</sup>:** rupture of pulmonary bleb.
- **2<sup>ry</sup>:**
  - Rupture of emphysematous bullae, solitary lung cyst or cystic lung.
  - Rupture of small sub-pleural TB cavity (in this case, there is an underlying pulmonary TB, and hydropneumothorax usually occurs).

## Pathological types

1. Closed pneumothorax (simple).
2. Open pneumothorax.
3. Tension pneumothorax.

## Pathophysiology

### 1. Respiratory failure (impairment of gas exchange):

#### ⇒ In open pneumothorax: due to

- i) Paradoxical respiration on the affected side which:

- **Expands** slightly during **expiration**.
- **Collapses** more during **inspiration**.

- ii) Pendulum respiration due to:

- Oscillation of air between the two lungs.
- Normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.

#### ⇒ In tension pneumothorax: due to

- i. Marked ↑ in intrapleural pressure → collapse of the underlying lung.
- ii. Mediastinal shift to the opposite side → collapse of the other lung.

### 2. Circulatory failure:

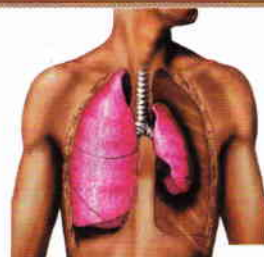
#### ⇒ In open pneumothorax: due to

- I) **Mediastinal flutter:** the mediastinum moves from side to side with respiratory movements leading to kinking of great vessels.
- II) **Loss of negative intrathoracic pressure** on the affected side → ↓ venous return → ↓ cardiac output.

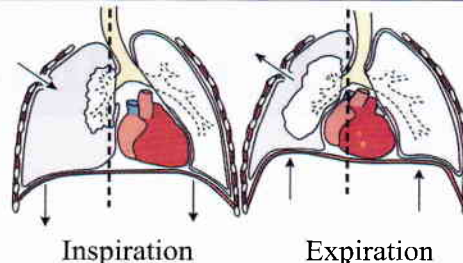
#### ⇒ In tension pneumothorax: due to

- Loss of the negative intrathoracic pressure → ↓ venous return → ↓ cardiac output.
- Mediastinal shift disturbs heart action.

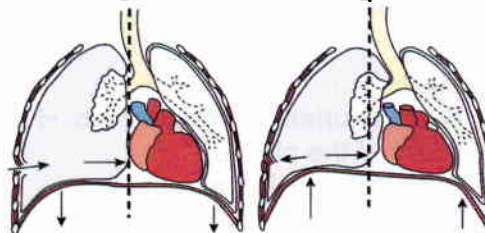
- ▶ Air in the pleural cavity
- ▶ It is types: open, closed, tension
- ▶ **C/P:** - **Symptoms:** history of trauma, chest pain, dyspnea, cough
- **Signs:** shock, engorged neck veins + tympanic resonance on percussion of the affected side
- ▶ **Invest.:** chest X ray showing jet black opacity on the affected side
- ▶ **TTT:** management of poly trauma patient + insertion of intercostals tube under water seal in the 2nd space mid clavicular line



### Open pneumothorax



### Tension pneumothorax



### Clinical picture

- Closed type: clinically, the condition is usually mild.
- Open type: clinically diagnosed by harsh whistling sound of air going through the defect following history of trauma.
- Tension type: it is a fatal emergency.

### Symptoms

- History of trauma.
- Acute chest pain, dyspnea, cough & cyanosis.

### Signs

- General (in tension & open types only): signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- Local:
  1. Inspection: - Ecchymosis & bruises.  
- ↓ Chest movements on affected side.
  2. Palpation: - Shift of trachea to the opposite side.  
- ↓ TVF.
  3. Percussion: **tympantic resonance** on affected side.
  4. Auscultation: ↓ air entry.

### Complications (associated injuries)

- 1- Chest wall: fracture rib and flail chest.
- 2- Pleura: hemothorax.
- 3- Diaphragmatic injury.
- 4- Great vessel injury.
- 5- Cardiac injury.
- 6- Lung lacerations.
- 7- Esophageal injury.

### Investigations

#### For diagnosis

##### CXR:

- Jet-black opacity on affected side.
- Total lung collapse on the affected side.
- Partial lung collapse on the opposite side.
- Tracheal and cardiac shadow shift to the opposite side.
- Flattened diaphragm is displaced downwards on the affected side.

**For complications**

- ABGs.
- U/S for associated visceral injuries.

**Treatment**

- **ABCD at the site of the accident:**
  - o Urgent insertion of a wide-bore cannula in the 2<sup>nd</sup> intercostal space (in tension pneumothorax).
  - o Close the wound by adhesive external dressing (in open pneumothorax).
- **Resuscitation & monitoring + 1<sup>st</sup> survey.**
- **Definitive treatment:** insertion of an intercostal tube under water seal in the 2<sup>nd</sup> space at the mid-clavicular line.

**Closed (simple) pneumothorax****Definition**

- A limited amount of air is entrapped into the pleural cavity (not communicating with the exterior).

**Symptoms**

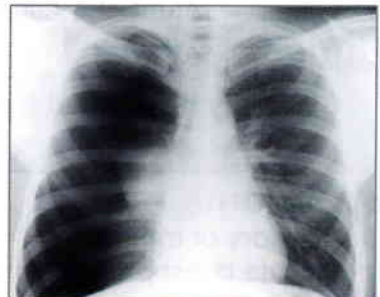
- History of the cause.
- Chest pain & slight dyspnea.

**Signs**

- **Inspection:** - ↓ movements at the affected side.
- **Palpation:** - Confirms diminished movements.  
- ↓TVF, but there is **NO** mediastinal shift.
- **Percussion:** - Hyper-resonance.
- **Auscultation:** - ↓ air entry.

**Investigations****Plain CXR shows:**

- Absence of lung markings (i.e. Jet-black).
- The edge of the collapsed lung is usually visible.



Rt. sided pneumothorax

**Treatment**

- **If the amount of air is small & there is no dyspnea:**  
→ The patient is treated **conservatively** (monitoring vital signs & repeated ABGs are done) until spontaneous absorption of the air takes place.
- **If there is dyspnea:**  
→ An **intercostal chest tube with under water seal** is inserted (until complete expansion of the collapsed lung occurs).

# Open pneumothorax

## Definition

- The pleural space communicates freely with the exterior.

## Etiology

- Open chest injury with a sucking wound.
- Closed chest injury with tracheobronchial injury or lung rupture.

## Pathology

### 1. Respiratory failure (impairment of gas exchange) due to:

- Paradoxical respiration: on the affected side which:
  - **Expands** slightly during **expiration**.
  - **Collapses** more during **inspiration**.
- Pendulum respiration due to:
  - Oscillation of air between the 2 lungs.
  - Normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.

### 2. Circulatory failure due to:

- Mediastinal flutter: the mediastinum moves from side to side with respiratory movements leading to kinking of great vessels.
- Loss of negative intrathoracic pressure on the affected side → ↓ venous return → ↓ cardiac output.

## Clinical picture

Clinically diagnosed by harsh whistling sound of air going through the defect following history of trauma

## Symptoms

- History of trauma.
- Acute chest pain, dyspnea, cough & cyanosis.

## Signs

- **General:**
  - Signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  - Inspection:
    - Ecchymosis & bruises.
    - ↓ Chest movements on affected side.
  - Palpation:
    - Shift of trachea to the opposite side.
    - ↓ TVF.
  - Percussion:
    - Hyper-resonance on the affected side.
  - Auscultation:
    - ↓ air entry.

## Investigations

### For diagnosis

- **CXR:**
  - Jet-black on affected side.
  - Total lung collapse on the affected side.
  - Partial lung collapse on the opposite side.

- ▶ The pleural space communicates freely with the exterior.
- ▶ **Etiology:** open, closed chest injury
- ▶ **Clinically** diagnosed by harsh whistling sound of air going through the defect following history of trauma+ Hyper-resonance on the affected side on percussion
- ▶ **Invest.:** - CXR:
  - Jet-black on affected side.
- ▶ **TTT:** management of poly trauma patient + insertion of intercostals



- Tracheal and cardiac shadow shift to the opposite side.
- Flattened diaphragm is displaced downwards on the affected side.

### For complications

- ABGs.
- U/S for associated visceral injuries.

### Treatment (emergency)

- **ABCD at the site of the accident:**
  - Close the wound by adhesive external dressing.
- **Resuscitation & monitoring + 1<sup>st</sup> survey.**
- **Definitive:**
  - The wound is sutured with insertion of an intercostal tube under water seal in the 2<sup>nd</sup> space at the MCL.

## Tension pneumothorax

### Definition

- Valvular tear which allows air to enter but does not allow it to come out from the pleural space.

### Etiology

- Valvular wound.

### Pathology

1. **Respiratory failure (impairment of gas exchange) due to:**
  - Marked ↑ in intrapleural pressure → collapse of the underlying lung.
  - Mediastinal shift to the opposite side → collapse of the other lung.
2. **Circulatory failure due to:**
  - Loss of the negative intrathoracic pressure → ↓ venous return → ↓ COP.
  - Mediastinal shift disturbs heart action.

- ▶ Valvular tear which allows air to enter but does not allow it to come out from the pleural space.
- ▶ **Etiology:** Valvular wound.
- ▶ **C/P:** As open pneumothorax but more severe cardio-respiratory distress
- ▶ **Invest.:** rarely needed
- ▶ **TTT:** insertion of cannula 14F in the cricothyroid membrane.  
+ An intercostal tube in the 2nd space at the mid-clavicular line with under-water seal.

### Clinical picture

As open pneumothorax but more severe cardio-respiratory distress

### Symptoms

- History of trauma.
- Acute chest pain, dyspnea, cough & cyanosis.
- Respiratory arrest may occur.

### Signs

- **General:** signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  1. **Inspection:** - Ecchymosis & bruises.  
- ↓ chest movements on affected side.
  2. **Palpation:** - Shift of trachea to the opposite side.  
- ↓ TVF.
  3. **Percussion:** - Tympanitic resonance on affected sides.
  4. **Auscultation:** - ↓ air entry.



## Complications (associated injuries)

- Chest wall: fracture rib and flail chest.
- Pleura: hemothorax.
- Diaphragmatic injury.
- Great vessel injury.
- Cardiac injury.
- Lung lacerations.
- Esophageal injury.

## DD

### *Of acute chest pain + shock*

1. Acute myocardial infarction.
2. Cardiac tamponade.
3. Massive pulmonary embolism.

## Investigations

*(Rarely needed)*

- They are done if diagnosis is suspicious.
- If not, proceed to urgent treatment that should be done once tension pneumothorax is diagnosed.

## Treatment

### First aid

- **Airway:** maintaining upper airways clear, even by insertion of cannula 14F in the cricothyroid membrane.
- **Breathing:** urgent insertion of a wide-bore cannula in 2<sup>nd</sup> intercostal space MCL.
- **Circulation:** control of bleeding by compression
- **D** → Damaged limb → should be splinted.  
→ Drugs → morphine if needed.

### At hospital

1. **Resuscitation & primary survey:**
  - a. Ryle, IV line and catheter.
  - b. IV fluids, blood transfusion, antibiotics & analgesics.
  - c. Blood transfusion.
2. **Continuous monitoring of:**
  - a. Level of consciousness.
  - b. Vital signs (pulse, BP, temperature, and RR).
  - c. Neck veins, CVP.
  - d. Urine output, fluid chart and amount of drained fluid.
3. **Secondary survey:**
  - After establishment of general condition of patient, 2<sup>ry</sup> survey has to be done.

### Specific treatment

- An **intercostal tube** in the 2<sup>nd</sup> space at the mid-clavicular line with under-water seal.
- Continuous bubbling of air through the intercostal tube denotes the possibility of occurrence of broncho-pleural fistula.
- Recently, the intercostal tube is inserted through the fifth space between the anterior and midaxillary lines, then:
  - ⇒ If pneumothorax → the tube is advanced towards the apex of the lung
  - ⇒ If hemothorax → the tube is advanced towards the base of the lung

# Pleural effusion

## Definition

- Abnormal accumulation of fluid in the pleural space

## Etiology

### (Trauma, Inflammation, Neoplasm)

- 1- Transudate (part of generalized edema)
- 2- Exudate (inflammation or malignancy) e.g.:
  - Pleurisy
  - T.B. or malignancy (it may contain ↑ RBCs = hemorrhagic).
  - Pancreatitis → Lt. sided effusion.
- 3- Bloody: hemothorax in chest injuries.
- 4- Chylous: obstruction of thoracic duct.

- ▶ Abnormal accumulation of fluid in the pleural space
- ▶ **Etiology:** exudate, transudate, bloody, chylous
- ▶ **C/P:** - **Symptoms:** chest pain, cough, dyspnea  
- **Sign:** Percussion: stony dullness (basal & rising to axilla)
- ▶ **Invest.:** chest x ray
- ▶ **TTT:** TTT of cause + Thoracocentesis

## Clinical picture

### Symptoms

- Pain (dull aching or stitching if active pleurisy).
- Cough, dyspnea.
- Of the cause.

### Signs

- Inspection: ↓ movement.
- Palpation: → trachea shifted to opposite side.  
→ ↓TVF.
- Percussion: stony dullness (basal & rising to axilla).
- Auscultation: ↓ air entry.

## Investigations

1. CXR:
  - Homogenous opacity.
  - Obliteration of costophrenic angle.
  - Rising to axilla.
2. Aspiration (thoracocentesis): diagnostic & therapeutic (differentiate exudate from transudate).

## Treatment

- 1- Treatment of the cause.
- 2- Thoracocentesis (gradually to avoid complications e.g. hemothorax).

# Hemothorax

## Definition

- Collection of blood in the pleural space.

## Etiology

### Local

- 1- Traumatic injury of intercostal vessels, internal mammary vessels or the lung tissue.
- 2- Post-operative.
- 3- Pathological → due to tumors.  
→ leaking aortic aneurism.

### General

1. Blood disease (hemophilia, purpura).
2. Hypertension.
3. Drugs as anticoagulant.

## Pathology

- The respiratory and cardiac movements defibrinate the blood, so that the collection remain fluid in most cases.
- Blood in the pleural space is very irritant exciting the formation of a considerable effusion that is rich in proteins.
- In neglected cases a fibrin layer is deposited on both layers of the pleura, later this deposit is transformed to a fibrous layer. The end result is a collapsed lung and deformity of the chest wall with crowding of the ribs.
- Blood is an excellent culture and infection is common.
- In traumatic cases, there is commonly associated pneumothorax, i.e., hemopneumothorax.

## Source of bleeding

- Pulmonary (lung lacerations) → non-progressive as pressure is low (lung is compressed by blood).
- Systemic e.g. heart, great vessels, intercostal arteries or internal mammary; this type is progressive → shock
- From abdomen in thoraco-abdominal injuries with injured organs (e.g. spleen) with ruptured diaphragm.

## Clinical picture

### Symptoms

- History of trauma.
- Dyspnea, chest pain.
- Hemoptysis** (if lung laceration occurs).

### Signs

- General:**
  - Signs of shock, engorged neck veins, cyanosis, working ala nasi.
  - Associated injuries

- ▶ Collection of blood in the pleural space.
- ▶ **Etiology:** as any bleeding general, local causes
- ▶ **C/P:** As pneumothorax but dull on percussion
- ▶ **Invest.:** chest x ray
- ▶ **TTT:** management of poly trauma patient + remove the blood by aspiration or thoracotomy if indicated



As pneumothorax but dull on percussion

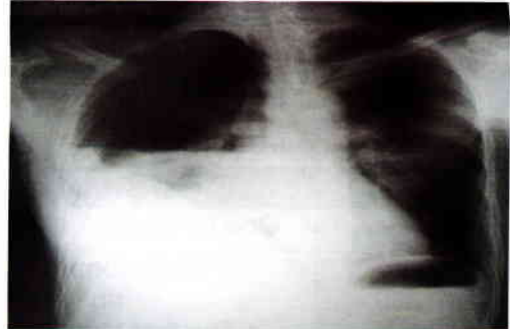
### Local:

- Inspection: ↓ chest movements.
- Palpation: ↓TVF.  
Tenderness.  
Shift of trachea to opposite side.
- Percussion: **Dullness**.
- Auscultation: ↓ air entry.

## Investigations

### For diagnosis

- **CXR** → If the hemothorax is less than 500 ml, it will lead to obliteration of costophrenic angle & if more than 500 ml it will lead to an opacity rising to axilla + site of fracture.
- **Aspiration** → blood.



### For complication

- ABGs.
- Investigations for associated injuries.

## Treatment

1. **ABCD** (in poly-traumatized patient).
2. **Resuscitation & monitoring then 1ry survey.**
3. **Complete removal of the blood from the pleura by:**
  - A. **Repeated aspiration** (if small in amount).
  - B. **Intercostal (I.C.) tube with underwater seal in the fifth intercostal space in the mid axillary line** (if re-accumulating)  
**Why?** To allow full lung expansion (ensured by X-ray).  
 To prevent clotting, infection, irritation & pleurisy.
4. **Thoracotomy: indicated if:**
  - Severe bleeding (200 ml/hour).
  - Persisting bleeding despite conservative measures.
  - Associated intrathoracic injuries.
  - Old clotted hemothorax → This is diagnosed by failure of the tube to evacuate the blood.
  - Loculated hemothorax → The tube partially evacuates the blood.
  - Presence of foreign bodies.
  - Initial volume of blood coming through the intercostals tube > 2L.
5. **For clotting:**
  - Fibrinolytics (early).
  - Decortication (if marked).
6. **Deal with associated injuries.**



# Rib fracture

## Etiology

1. **Direct trauma** → May produce fracture at any site. Visceral injury is common as the broken ends are driven inwards
2. **Indirect trauma** → antero-posterior compression of the ribs → fracture at the angle and since the broken ends are driven outwards visceral injury is uncommon.
3. **Muscular violence** → as in convulsions, violent sneezing or coughing.
4. **Pathological fracture.**

- ▶ **Etiology:** direct, indirect, pathological fracture
- ▶ **Types:** Simple, Multiple, Flail chest, stove in chest
- ▶ **C/P:** history of trauma + chest pain, dyspnea, swelling at the site of injury
- ▶ **Invet.:** chest x ray, ABGs
- ▶ **TTT:** management of poly trauma patient + specific TTT according to the type of fracture

## Types

|            | 1-SIMPLE                                                                                                                                                                                                                                                                                     | 2-MULTIPLE                               |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Definition | One rib fracture at one point                                                                                                                                                                                                                                                                | Multiple ribs fracture each at one point |
| Sites      | <ul style="list-style-type: none"> <li>▪ More common in 3<sup>rd</sup>-10<sup>th</sup> ribs, often at the most convex part of the rib (at axilla) following antero-posterior compression.</li> <li>▪ The first two ribs are protected by clavicle &amp; the last two are floating</li> </ul> |                                          |

## 3- FLAIL CHEST:

- **Definition:**
  - More than one rib (at least 4) is fractured at more than one site.
  - A segment loses its bony continuity with the rest of the chest wall.
- **Pathology:**
  1. **Respiratory failure (impairment of gas exchange) due to:**
    - Paradoxical respiration;* the lung at the side of injury
      - **expands** slightly during **expiration**
      - **collapses** more during **inspiration**.
    - Pendulum respiration* due to:
      - Oscillation of air between the 2 lungs.
      - The normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.
  2. **Circulatory failure due to:**
    - Mediastinal flutter.* the mediastinum move from side to side with respiratory movements leading to kinking of great vessels.

## 4- STOVE IN CHEST:

- Fracture of a rib or more at more than one point. The intermediate segment of the fractured ribs is sucked to the inside and fixed in place leaving a deformity in the form of a groove or depression in the chest wall (if marked → ↓ vital capacity).

## Clinical picture

### Symptoms

1. History of trauma to the chest.
2. Severe pain.
3. Swelling at the site injury.
4. Dyspnea.



## Signs

- **General:** working ala nasi & cyanosis if multiple rib fracture.
- **Local:**
  - Inspection: ecchymosis, bruises & limited chest movements.
  - Palpation: tenderness & crepitus at the site of fracture.
  - Auscultation: ↓ air entry.
  - Evidence of underlying chest injuries (hemothorax, open or tension pneumothorax).
  - Evidence of associated abdominal injuries (liver, spleen or kidney).

## Complications

- 1- Pneumothorax.
- 2- Hemothorax.
- 3- ↓ Respiratory movements leading to atelectasis & chest infection.
- 4- Rupture mediastinum.
- 5- Rupture kidney.
- 6- Rupture spleen (left side).
- 7- Rupture liver (right side).

1<sup>st</sup> rib fracture is potentially dangerous as it is associated with injury to great vessels

## Investigations

- 1- Plain X-ray.
- 2- ABGs: ↓ O<sub>2</sub> saturation and ↑ CO<sub>2</sub> saturation in blood.

## Treatment

1. **ABCD** (if poly-traumatized patient).
2. **Resuscitation & monitoring then 1<sup>st</sup> survey.**
  - Pain relief:
    - Analgesics.
    - Intercostal nerve block or epidural anesthesia.
3. **Specific treatment:**
  - ⇒ **Simple** → strapping is better to be avoided.
  - ⇒ **Multiple** → strapping or intermittent positive pressure breathing (IPPB).
  - ⇒ **Flail chest** →
    - 1- Emergency strapping & emergency tracheostomy.
    - 2- IPPB.
    - 3- Skeletal traction on the sunken ribs or open reduction + internal fixation by stainless steel wire sutures.
    - 4- Positive end expiratory pressure (PEEP).
  - ⇒ **Stove in the chest** →
    - Adhesive strapping.
    - Reduction by traction.
    - Internal fixation if there is another indication for thoracotomy or for cosmetic reasons.

# 1- Simple fractured rib

## Definition

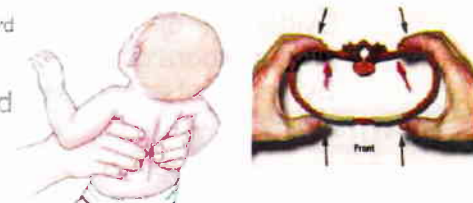
- Only one rib is fractured at one point.

## Incidence

- The most common ribs to be fractured are 3<sup>rd</sup> up till 10<sup>th</sup>.
- The first two ribs are protected by clavicle and the last 2 are floating.

## Causes

- Usually due to anteroposterior compression.



shaking the baby(A-P compression ) cause rib fracture

## Site

- Often the most convex part of the rib i.e. at the axilla.

## Treatment

- 1- **Ensuring patency** of lower airway is a must.
- 2- **Analgesics** should be given liberally up to pethidine (however, do not give at extremes of age and in presence of head injury → **Intercostal nerve block** or epidural analgesia is helpful).

**N. B.** Strapping is better to be avoided since it restricts respiratory movements; also, the fractured rib is efficiently splinted by its neighboring ribs)

*Morphine is contraindicated except if you have to support ventilation*

# 2-Multiple fractured ribs

## Definition

- More than one rib is fractured and each rib is fractured at one point.

## Treatment

- a. **ABCD.**
- b. **Ensure patency of the airways.**
- c. **Analgesic** can be used liberally.
- d. **Intercostal nerves block** or epidural analgesia can be helpful.
- e. **Immobilization:** either by:
  - External immobilization:
    - Adhesive strapping.
    - Continuous balanced traction using weight and overhead pulley.
  - Internal immobilization:
    - IPPB or controlled ventilation using artificial ventilation if needed.
    - Practically, internal fixation is rarely used unless there are other indications for thoracotomy.



## 3- Flail chest

### Definition

- More than one rib (at least 3) is fractured at more than one site.
- A segment loses its bony continuity with the rest of the chest wall.

### Etiology

- Direct trauma.

### Pathology

⇒ *The flail part has the following effects:*

1. The flail part moves paradoxically with respiration
  - During **inspiration**, chest expands while the flail part is **sucked in**.
  - During **expiration**, chest collapses while the flail part **bulges out**.
2. Respiratory failure (impairment of gas exchange) due to:
  - Paradoxical respiration; the lung at the side of injury
    - **expands** slightly during **expiration**.
    - **collapses** more during **inspiration**.
  - Pendulum respiration due to:
    - Oscillation of air between the 2 lungs.
    - The normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.
3. Circulatory failure due to:
  - Mediastinal flutter
    - The mediastinum move from side to side with respiratory movements leading to kinking of great vessels.

### Clinical picture

#### History of trauma

#### Symptoms

- Acute chest pain, dyspnea, cough & cyanosis.

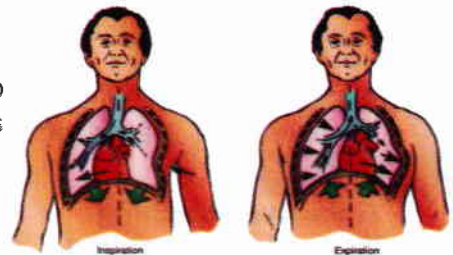
#### Signs

- **General:** signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  1. Inspection:
    - Ecchymosis & bruises.
    - ↓ Chest movements on affected side.
    - Flail segment moves paradoxically with respiration.
  2. Palpation:
    - Tenderness.
    - ↓ TVF & shift of trachea to the opposite side if associated with pneumothorax.
  3. Auscultation: ↓ air entry.

### Complications

1. Pneumothorax.
2. Hemothorax.
3. Rupture kidney.
4. Rupture spleen (left side).
5. Rupture liver (right side).

- ▶ More than one rib (at least 3) is fractured at more than one site.
- ▶ The flail part has the **following effects** : respiratory and circulatory failure
- ▶ **C/P: - Symptoms:** Acute chest pain, dyspnea, cough & cyanosis.
- **Signs:** signs of shock, engorged neck veins, cyanosis
- ▶ **Invest.:** for flail chest and complications
- ▶ **TTT:** Management of poly trauma+ definitive TTT according to the finding



## Investigations

### Investigation of flail chest

1. CXR & CT scan.
2. ABG & KFTs.

### Investigation of complications

1. U/S → rupture spleen.
2. Hemothorax → obliteration of costo-phrenic angle + fluid rising to axilla.

## Treatment

1. **First aid: ABCD** at the site of accident.

2. **At hospital:**

- Resuscitation & monitoring
- **If small flail segment** → control the paradoxical movement by **strapping** the chest over firm pad or fixing it to bedside using towel clips is enough.
- **If there is severe paradoxical respiration** → introduce endotracheal tube and start **positive pressure respiration** (after exclusion of tension pneumothorax).
- **If there is an indication for thoracotomy** →
  - ⇒ **Open reduction & internal fixation** (wiring) of fractured ribs.
- If the period of required ventilation is more than 10 days, it is preferable to do a tracheostomy to avoid laryngeal stenosis with prolonged endotracheal intubation.

## 4- Stove in chest

- A rib or more is fractured at more than one point and the intermediate segment of the fractured rib/ribs is sucked to the inside and fixed in place leaving a deformity at its place in the form of a groove or depression in the chest wall.
- If marked → ↓ vital capacity

## Treatment

- **Adhesive strapping.**
- **Reduction by traction.**
- **Internal fixation:** if there is another indication for thoracotomy or for cosmetic reasons.



# Pulmonary contusion

## Etiology

- Impact injuries to the chest wall.

## Pathology

- They lead to outpouring of fluid in the walls of the alveoli and into the alveolar spaces with the development of pulmonary edema and pneumonitis.
- Disturbance occurs in the ventilation perfusion ratio in the contused areas leading to diminished oxygenation of the blood and eventually tissue hypoxia occurs.

## Treatment

- Conservative → antibiotics and physiotherapy.



# Empyema

## Definition

- Accumulation of pus in the pleural cavity.

## Types

- Acute:**
  - Non-specific.
  - Specific → TB.
- Chronic:**
  - Non-specific.
  - Specific.

## (I) Acute empyema

### Predisposing factors

- More common in children following lobar pneumonia.

### Route of infection

- Local spread:**
  - From chest → pneumonia, mediastinitis or osteomyelitis.
  - From abdomen → subphrenic or liver abscesses.
- Direct access** through open wounds (post-traumatic or post-operative).
- Blood spread:** as in septicemia.

- Accumulation of pus in the pleural cavity.
- More common in children following lobar pneumonia.
- Pneumococcal empyema is the commonest type
- C/P: - Symptoms:** FAHM + chest pain, cough, dyspnea
- Signs:** fever, tachycardia+ local signs of collections of pus in the pleural
- Invest.:** CXR, CBC
- TTT:** as Abscess 3A+ Drainage

### Causative organisms

(Pathological types)

#### 1- Staphylococcal empyema

- Direct from pneumonia or blood spread from septicemia.

#### 2- Putrid empyema

- Following rupture of lung or subphrenic abscess (mixed infection → E.coli, Proteus, Pseudomonas).

|                     | 3- Pneumococcal empyema                       | 4- Streptococcal empyema                                     |
|---------------------|-----------------------------------------------|--------------------------------------------------------------|
| <b>Incidence</b>    | The commonest                                 | Less common                                                  |
| <b>Onset</b>        | After lobar pneumonia = metapneumonic empyema | Synchronously with broncho-pneumonia = synpneumonic empyema. |
| <b>Pus</b>          | Thick, green                                  | Thin, yellow                                                 |
| <b>Localization</b> | Adhesions occur early                         | No adhesions, no localization and empyema is massive.        |

### Stages

- Diffuse stage.
- Localized stage.
- Neglected stage.



## Clinical picture

### Symptoms

- **General:** marked constitutional symptoms (FAHM, rigors).
- **Local:** cough, dyspnea & dull aching chest pain.

### Signs

- **General:** fever, tachycardia, cyanosis & working ala nasi.
- **Local:**
  - **Inspection:** ↓ chest movements.
  - **Palpation:** ↓TVF + shift of the mediastinum.
  - **Percussion:** dullness.
  - **Auscultation:** ↓ air entry.

### Complications

- **General:** toxemia, bacteremia, septicemia, pyemia.
- **Local:** chronic empyema & spread (→ lung abscess).

### Investigations

- **CXR:** obliterated costo-phrenic angle with opacity rising towards the axilla.
- **Blood picture:** leucocytosis + ↑ ESR.
- **Thoracocentesis:** reveals pus → C & S.

### Treatment

#### General

- Rest.
- Analgesics, antibiotics, antipyretics (AAA).

#### Local

- 1) **Aspiration:** in early stages  
Through the 7<sup>th</sup> space at the midaxillary line repeated until complete drainage occurs, with injection of antibiotics (500.000 units penicillin).
- 2) **Closed drainage:** if pus collects rapidly or if pus becomes too thick to be aspirated.  
By insertion of intercostal tube connected to an under water seal through 7th space at the midaxillary line.
- 3) **Open surgical drainage:** by rib resection + surgical evacuation of pus.  
**Only when full localization has occurred.**

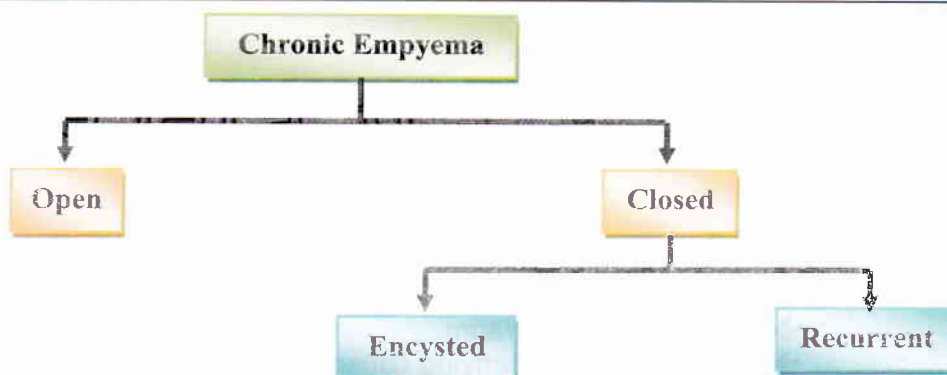
## (II) Chronic empyema

### Definition

- Empyema in which the lung is unable to expand after pus evacuation due to fibrosis.

- ▶ Empyema in which the lung is unable to expand after pus evacuation due to fibrosis.
- ▶ May be open, closed
- ▶ **C/P:** - **General:** Chronic toxemia with clubbing
  - **Local:**
    - Open type: → chronic sinus in the chest wall
    - Closed type: Empyema necessitans
- ▶ **Invest.:** CBC, chest X ray
- ▶ **TTT:** - **General:** Antibiotic, correct the general condition
  - **Local:** Re-drainage, Decortication, Thoracoplasty

## Types

**(1) Open chronic empyema (chronic chest wall sinus):**

It is due to inadequate treatment of acute empyema

- Inadequate drainage (too early, too late, too high or too low drainage).
- Inadequate post-operative care: as early removal of the IC tube.
- Underlying disease: in chest wall (osteomyelitis of ribs), pleura (TB, foreign body) lung (abscess or tumors).
- Poor general condition: anemia, D.M...etc.

**(2) Closed chronic empyema:**

- Encysted empyema: develops insidiously as the closed collection of pus is completely walled off by adhesions.
- Recurrent empyema: discharging pus intermittently into a bronchus through a bronchopleural fistula.

## Clinical picture

## General

- Chronic toxemia with clubbing.
- Acute exacerbations with fever & chills.

## Local

- Open type → chronic sinus in the chest wall leading to the pleura & discharging pus.
- Closed type → **Empyema necessitans**, which perforates an intercostal space leading to a subcutaneous abscess (gives an expansile impulse on cough).
- Due to fibrosis:
  - Contracture and rigidity of chest wall with crowding of ribs from fibrosis.
  - Elevation of the diaphragm.
  - Shift of the mediastinum towards the affected side due to fibrosis.
  - Scoliotic deformity of the spine.

## Complications

**A. General:** septicemia, pyemia, 2<sup>ry</sup> amyloidosis in kidney.

**B. Local:** spread of infection to the surroundings e.g.

1. Pulmonary fibrosis.
2. Bronchopleural fistula.
3. Sinus.
4. Empyema necessitans.
5. Subphrenic abscess.

## Investigations

### Laboratory

- Culture and sensitivity: for sputum or pus.
- Complete blood picture: anemia, ↑ ESR + leucocytosis.

### Radiological

- Plain CXR:
  - ➔ Overcrowded ribs.
  - ➔ Shift of trachea.
  - ➔ Elevation of diaphragm.
  - ➔ May show the underlying cause.
- CT scan chest & biopsy: **most accurate**.
- Lipidol pleurogram: shows the size of the cavity + any bronchial communications.

### Instrumental

- Bronchoscopy to detect any cause.

## Treatment

### General

- Correction of anemia & control DM.
- Antibiotics according to culture & sensitivity.
- Multivitamins.

### Local

- **Re-drainage** by rib resection in a dependent position + proper physiotherapy to allow lung expansion and obliteration of the cavity.
- If expansion of the lung doesn't follow re-drainage:
  - **Decortication**: the thick visceral pleura is excised and the lung is expanded by positive pressure ventilation.
  - **Thoracoplasty**: for localized cases, the cavity is obliterated by allowing the chest wall to adhere to the lung.

## Tuberculous empyema

### ➤ Etiology

- may occur as a complication of:
  1. Rupture of a tuberculous cavity.
  2. T.B. pleural effusion.
  3. Operations on tuberculous lungs.

### ➤ Treatment

- **In the absence of secondary infection:**
  - Sanatorial treatment
  - Repeated aspiration.
  - Anti-tuberculous treatment.
  - If these fail, decortication is performed.
- **Cases with secondary infection:**
  - Prolonged drainage until the secondary infection is overcome followed by decortication.
  - Associated lung disease or bronchopleural fistula *is dealt with by lobectomy or pneumonectomy at the time of decortication.*

# Adult respiratory distress syndrome (ARDS)

## Definition

- Lung condition that leads to low  $O_2$  level in blood.
- It is also called: **non-cardiogenic pulmonary edema**.

## Etiology

1. Severe sepsis. Patients in septic shock are particularly at risk of developing ARDS.
2. Severe shock (any type) especially if requiring large volumes of IV fluids.
3. Major trauma.
4. Extensive burns.
5. **Iatrogenic factors:**
  - Non-filtered blood transfusion.
  - Overtransfusion of fluids.
  - Use of oxygen concentrations over 50%.
  - Massive doses of steroids.
6. Lung injury due to trauma, inhalation of fumes or aspiration of gastric contents.

- ▶ Lung condition that leads to low  $O_2$  level in blood.
- ▶ **Etiology:** sepsis, shock, major burn and trauma
- ▶ **Characterized by** damage of alveolar-capillary membrane which leads to defect in ventilation/perfusion/diffusion
- ▶ **C/P:** initial state, phase of hemodynamic equilibrium, phase of respiratory distress
- ▶ **Investigation:** ABG, CXR, CT chest
- ▶ **TTT:** NO SPECIFIC THERAPY BUT JUST supporting and symptomatic TTT

## Pathophysiology

- ARDS is associated with severe and diffuse injury to the **alveolar-capillary membrane** (the air sacs and small blood vessels) of the lungs.
- Some alveoli distend with fluids, while some other alveoli collapse.
- This alveolar damage impedes the exchange of oxygen and carbon dioxide, which leads to a reduced concentration of oxygen in the blood.
- Defect in the 3 aspects of the respiratory process (ventilation / perfusion / diffusion).
- Hypoxia causes damage to other vital organs of the body such as the kidneys.

## Pathology

### Macroscopic picture

- Great increase in lung weight.
- Petechial hemorrhages on epithelial surfaces.

### Microscopic picture

- Interstitial edema and hemorrhage.
- Alveolar edema.
- Peri-alveolar hemorrhage.
- Inconstantly, intravascular fat globules and fibrin plugs.

## Clinical Diagnosis

1. **Medical history** of conditions that can lead to ARDS e.g. severe pneumonia.
2. **Initial state:**
  - Shock
  - Lactic acidosis
  - Hyperventilation (low  $PaCO_2$ , but  $PaO_2$  may be normal or slightly low).
3. **Phase of hemodynamic equilibrium (lasts for several days):**
  - The patient may appear well recovering
  - Chest X-ray is normal
  - $PaO_2$  is invariably low
4. **Phase of clinical respiratory distress followed by respiratory failure:**
  - Confusion and occasional petechial rash.
  - Chest x-ray reveals bilateral pulmonary infiltrations.
  - Rising  $PaCO_2$  and falling  $PaO_2$  occur despite oxygen supplement.



## Complications of ARDS

- 1- Infection.
- 2- Pneumothorax.
- 3- Deep vein thrombosis (DVT) & pulmonary embolism.
- 4- Lung scarring:
  - ARDS causes the lungs to become stiff (scarred) → cannot expand.
  - Being on a ventilator for a long time also can cause lung scarring.

## Investigations

### ▪ Laboratory:

- a- ABG: reveals hypoxemia (reduced levels of oxygen in the blood).
- b- CBC: ↑WBCs in sepsis.

### ▪ Radiological:

- a- CXR: may show the presence of fluid in the lungs.
- b- CT scan chest: may be required only in some situations (routine chest x-ray is sufficient in most cases).
- c- Echocardiogram: exclude heart problems that cause fluid build-up in the lung.

### ▪ Instrumental:

- a- Monitoring with pulmonary artery catheter may be needed to exclude a cardiac cause for the difficulty in breathing.
- b- Bronchoscopy may be considered to evaluate the possibility of lung infection.

## Treatment (No specific therapy for ARDS exists.)

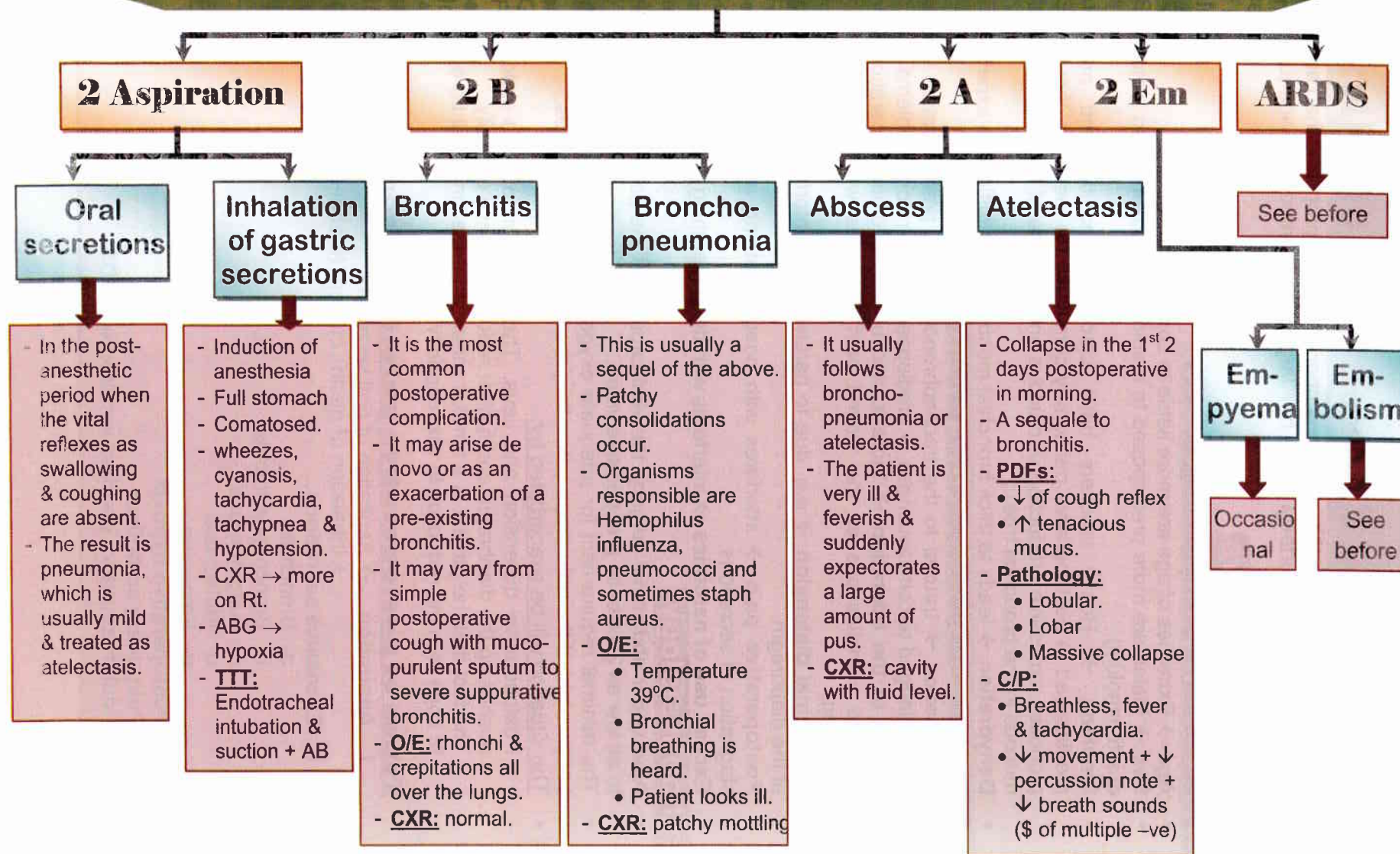
- Admission to an **intensive care unit (ICU)**.

### ▪ Treatment is primarily supportive using:

1. **Supplemental oxygen**.
2. **Mechanical ventilator** (in the stage of respiratory failure indicated by a  $\text{PaO}_2 < 60 \text{ mmHg}$ ).
3. **Treatment of the cause** e.g. correction of shock and eradication of sepsis.
4. **IV fluids** are given to provide nutrition and prevent dehydration, and are carefully monitored to prevent fluid from accumulating in the lungs (pulmonary edema).
5. The following **drugs** may be administered:
  - Antibiotics to treat infection because it is often the cause of ARDS.
  - Anti-inflammatory drugs, such as corticosteroids, to reduce inflammation in the lungs in the late phase or sometimes if the person is in septic shock.
  - Diuretics to eliminate fluid from the lungs.
  - Drugs to counteract low blood pressure that may be caused by shock.
  - Anti-anxiety drugs to relieve anxiety.
  - Inhaled drugs administered by respiratory therapists to decrease inflammation and provide respiratory comfort.



# POST-OPERATIVE PULMONARY COMPLICATIONS



# Postoperative Pulmonary Complications

- More surgical patients probably die of postoperative chest problems than anything else.
- Such morbidity and mortality can be largely prevented by adequate pre-and postoperative care.

## Predisposing factors

### A. Preoperative predisposing factors

- **Age** → Extremes of age are more liable to complications.
- **Sex** → Males are more predisposed to respiratory problems than females probably due to smoking.
- **Smoking** → Heavy smokers have chronic bronchitis, and are therefore, predisposed to postoperative pulmonary complications (because chronic bronchitis produces excessive production of mucous and damage of the cilia → stagnation of mucous in the bronchial tree).
- **Dehydration** → leads to thick bronchial mucous that is difficult to expel.

### B. Operative and post-operative predisposing factors

- **Anesthetics** → trauma to the tracheobronchial tree, premedication with atropine and prolonged unconsciousness → predispose to respiratory problems.
- **Nature of the operation** → thoracic and upper abdominal operations are more liable to complications as the wound pain interferes with deep breathing and coughing.
- **Abdominal distension** → e.g. due to paralytic ileus interferes with the movement of the diaphragm.
- **Postoperative pain** → interferes with deep breathing and coughing leading to stagnation of secretions.
- **Excess use of narcotics** → interferes with deep breathing and coughing.

## Pathophysiology

- After upper abdominal surgery, the vital capacity of the patient's lungs often drops to as low as 25% of its preoperative value.
- The minimal requirement for adequate oxygenation is 10 ml of vital capacity/kg of body weight. If the ratio drops below this, respiratory failure ensues.
- The situation will be exacerbated by:
  - Postoperative distension and ileus. The reduction of intra-abdominal space pushes up the diaphragm and further reduces the vital capacity.
  - The fact that the patient is a smoker means that the lungs will be even less able to cope with the reduction in vital capacity.

## **Types of postoperative pulmonary complications**

- I. **Aspiration** → Aspiration of oral secretions  
→ Inhalation of gastric content (Mendelson's syndrome)
- II. **Excessive secretions:**
  - a- Bronchitis
  - b- Bronchopneumonia
  - c- Lung abscess
  - d- Atelectasis
  - e- Empyema
- III. **Postoperative hypoxia**
- IV. **Pulmonary embolism**
- V. **Adult respiratory distress syndrome (ARDS)**

## I- Aspiration

### a- Aspiration of oral secretions

- It occurs in the post-anesthetic period when the vital reflexes as swallowing & coughing are absent.
- The result is pneumonia, which is usually mild & treated as atelectasis.

### b- Inhalation of gastric contents (**Mendelson's syndrome**)

#### Etiology

- It occurs during induction of anesthesia in a patient who has a full stomach or has intestinal obstruction.
- It can also occur in comatose patients, e.g. after head injury or drug poisoning.

#### Clinical picture

- Clinically manifested by wheezes, cyanosis, tachycardia, tachypnea & hypotension.
- The result is severe pneumonitis, which may be fatal.

#### Investigations

- Radiologically → widespread lung infiltration occurs more on the right than on the left and more in the lower lobes.
- Blood gas analysis → severe hypoxia.

#### Treatment

- **Prophylaxis** → all high-risk patients should have a nasogastric tube inserted before the operation for suction of the gastric contents.
- **Endotracheal intubation & suction** of the aspirated material followed by cleaning with saline irrigations.
- **Antibiotics** are given together with corticosteroids.

## II- Excessive Bronchial Secretions

These are responsible for the majority of post-operative chest complications

### 1- Bronchitis

- It is the most common postoperative complication.
- It may arise de novo or as an exacerbation of a pre-existing bronchitis.
- It may vary from simple postoperative cough with muco-purulent sputum to severe suppurative bronchitis.
- **O/E:** rhonchi & crepitations all over the lungs.
- **CXR:** normal.

### 2- Bronchopneumonia (Aspiration pneumonia)

- This is usually a sequel of the above.
- Patchy consolidations occur.
- Organisms responsible are Hemophilus influenza, pneumococci and sometimes staph aureus.
- **O/E:**
  - Temperature 39°C.
  - Bronchial breathing is heard.
  - Patient looks ill.
- **CXR:** patchy mottling.

### 3- Atelectasis

- Pulmonary collapse.
- It usually occurs in the first two days post-operative, in the morning.
- It is produced by occlusion of a bronchus by viscid secretions of mucus or pus & is a sequel to bronchitis.
- The obstruction leads to atelectasis of the affected lobe.

- **It is predisposed to by:**

- ↳ Depression of cough reflex, by pain or sedation & poor ventilation.
- ↳ Production of tenacious mucus due to:
  - *Pre-operative respiratory tract infection.*
  - Premedication with atropine.
  - Prolonged ether anesthesia.
  - Inhalation of foreign bodies, vomitus or septic material.
  - Post-operative dehydration.

### Pathology

- Obstruction of a bronchus by a plug of mucous is followed by absorption of air distal to the obstruction and deflation of the affected area.
- **The consequent collapse may be:**
  1. **Lobular:** collapse of scattered areas throughout the lung.
  2. **Lobar:** collapse of one lobe usually the lower.
  3. **Massive:** collapse of the whole lung.

### Clinical picture

- The patient does not feel well, is breathless & there may be fever & tachycardia.
- Restricted movement of the affected side of the chest with impaired percussion note & diminished breath sounds.
- Slight cough and sputum is difficult to expel and scanty.

### Investigations

- **CXR:**
  - The collapsed lobe appears as a homogeneous wedge-shaped opacity.
  - Major atelectasis causes approximation of the ribs, elevation of the diaphragm and deviation of the mediastinum toward the affected side.

### 4- Lung abscess

- It usually follows broncho-pneumonia or atelectasis.
- The patient is very ill & feverish & suddenly expectorates a large amount of pus.
- **CXR:** cavity with fluid level.

### 5- Empyema

- It is an occasional complication of any of the above.

### Treatment

#### ☞ **Prophylactic:**

1. Postpone operations in patients with bronchitis until treated properly.
2. They should be taught breathing & coughing exercises.
3. Smoking should be stopped for several days before operation.
4. Dental sepsis should be treated.
5. At the end of the operation, the tracheo-bronchial tree should be aspirated thoroughly.
6. Early return of consciousness & cough reflex should be aimed to.
7. Breathing & coughing exercises started very soon after recovery.
8. Pain is controlled by small doses of pethidine → it does not depress respiration.

#### ☞ **Established case:**

- 1- Physiotherapy, steam inhalations and expectorants → encourage expectoration.
- 2- If not enough → catheter suction is performed.
- 3- If not effective → bronchoscopic suction of bronchial tree under local anesthesia.
- 4- If atelectasis recurs, bronchoscopy is repeated or tracheostomy is done (better) especially when the secretions are profuse. It diminishes the dead space, & provides easy access for repeated aspirations.
- 5- Sputum is examined microscopically & cultured → proper antibiotic is given.



## IV- Post-operative hypoxia

➔ It is common and serious condition.

### Manifests clinically by

- Restlessness, anxiety or confusion.
- Tachypnea.
- Tachycardia, arrhythmias or hypotension.
- Central cyanosis is late.

### Common causes

- Pulmonary aspiration.
- Failure to breathe deeply and cough during recovery from anesthesia.
- Airway block by secretions.
- Hypoventilation due to pain of upper abdominal or thoraco-abdominal incisions, opiates overdose or prolonged recumbency.
- Pulmonary embolism.
- Pulmonary edema.

### Investigations

1. pulse oximetry.
2. ABG; increased PCO<sub>2</sub> denotes ventilation failure and decreased PO<sub>2</sub> denotes oxygenation failure.
3. Chest x-ray

### Treatment

- Treat the specific cause.
- The patient may need mechanical ventilation.

## III- Pulmonary embolism

- See vascular surgery

## IV-Adult respiratory distress syndrome (ARDS)

➤ See before

# Cardiac arrest & Cardio-pulmonary resuscitation (CPR)

## Definition

- Sudden failure of the heart to maintain circulation (No COP).

The brain can tolerate no more than 3 minutes of arrest before irreversible damage and death

## Types

*(Differentiated by ECG)*

- 1- Ventricular fibrillation (VF) → the most common type and the best survival rate.
- 2- Asystole.
- 3- Electromechanical dissociation.

## Causes

### A- Myocardial depression:

1. Myocardial anoxia e.g. myocardial infarction, shock, asphyxia...etc.

#### 2. Metabolic:

- a- Hyperkalemia / hypokalemia.

- c- Acidosis.

3. Vagal stimulation e.g. catheterization.

4. Gas poisoning.

- b- Hyponatremia.

- d- Drugs e.g. adrenaline IV → VF



5. Electrocutation.
6. Severe trauma.
7. Myocardial disease which ↓ the vitality of myocardium or interferes with the conduction as in Stokes-Adam's attacks.

### **B- Inadequate venous return:**

- 1- Mechanical:
  - Massive pulmonary embolism.
  - Cardiac tamponade.
  - Pleural effusion.
- 2- Acute hemorrhage.
- 3- General or spinal anesthesia.

### **Diagnosis**

- 1- Sudden loss of consciousness.
- 2- Absence of carotid pulse.
- 3- Cessation of respiration.
- 4- Bilateral dilated fixed pupil (relatively late sign)

The stethoscope has no place in the diagnosis of cardiac arrest. Once the condition is suspected the carotid vessels are palpated and if no pulse is felt, cardiac arrest must be assumed and resuscitation is started immediately

### **Management**

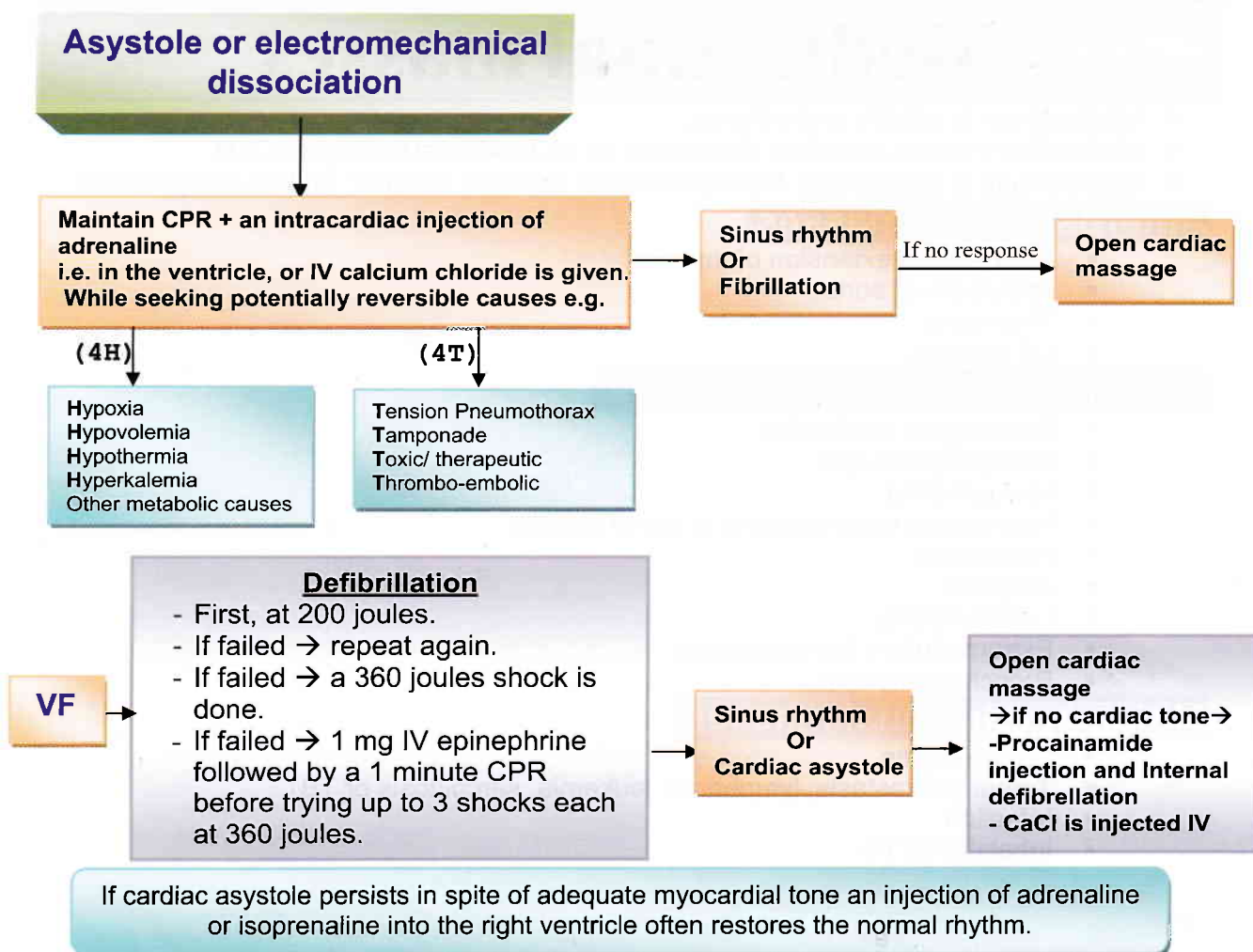
- The proper management is carried out immediately and consists of three phases.

#### **i. Pre-hospital management (cardiopulmonary resuscitation) = (CPR)**

- ▶ External CPR by direct mouth-to-mouth breathing and closed cardiac massage.
- ▶ The aim is not to restart the heart but to provide an artificial circulation and artificial ventilation until appropriate facilities are available.
- ▶ **Technique:**
  1. The patient is laid on firm surface and the legs raised to increase the V.R. the head is tilted back with one hand to ensure clear airway, and the nostrils are closed by the other hand while the mouth is applied to the patient mouth's to fill his lung with expired air at a rate of 10-15 times per minute.
  2. At the same time, another person performs external cardiac massage by compressing the lower half of the sternum against the spine at a rate of about 100 times per minute ( alternate 2 breaths and 30 sternal compressions). The person compressing the sternum should stop while the otherb gives mouth-to-mouth breathing.
  3. The efficiency of ventilation and massage must be monitored by observing chest expansion and palpating the femoral pulse. The patient should be transferred to the hospital as soon as possible while continuing CPR until endotracheal intubation and medical treatment are available.

#### **ii. Hospital management:**

1. The aim is to restore the normal cardiac rhythm.
2. An endotracheal tube is passed and the lung are ventilated with O<sub>2</sub>.
3. A venous cannula is inserted and suitable infusions are given.
4. ECG monitoring is applied to differentiate cardiac asystole from ventricular fibrillation or tachycardia.
  - Open cardiac massage is employed if the chest is already opened or if closed massage has been unsuccessful.
  - The chest is opened through the left 5<sup>th</sup> intercostal space and the pericardium is widely opened to permit bimanual massage with one hand above and the other below the ventricular mass.
  - Massage is continued at a rate of 60-80/min until the cardiac tone returns and the heart becomes smaller, firmer and pinker.



### iii. Subsequent treatment (in ICU):

*(After correction of normal rhythm)*

- Control blood pressure (kept over 90)
- If the chest has been opened it is left open for half an hour to watch for refailure of the heart.
- Control hyperkalemia →  $\text{CaCl}_2$ , glucose, insulin.
- Control hypothermia & dehydration.
- Control metabolic acidosis →  $\text{NaHCO}_3$  8.4%
- If recurrent VF → prophylaxis lignocaine or implantable cardioverter defibrillator.
- Anticonvulsants agents for convulsions (may result from severe anoxic cerebral damage).

➤ **After stabilization of the case, find and treat the primary cause (e.g. coronary bypass surgery for coronary occlusion).**

# Mediastinal masses

- ⇒ Mediastinum is usually a silent area.
- ⇒ Mediastinal masses are often discovered as an incidental finding on CXR.
- ⇒ Mediastinum is divided into 4 compartments: superior, anterior, middle and posterior.

## Anterosuperior masses

- Retrosternal extension of thyroid.
- Aneurysm of aorta.
- Thymoma.
- LN masses.

## Posterior mediastinum masses

- Esophageal duplication.
- Bronchogenic cyst.
- Hiatus hernia.
- Neurogenic tumors arising in nerve sheath.
- Hematoma.
- Abscess.
- Lymph nodes.
- Extramedullary hematopoiesis
- Bronchogenic cyst.

## Middle mediastinal masses

- Lymph nodes.
- Tumor (metastasis, lymphoma, leukemia, sarcoidosis or TB).
- Infection.
- Inhalational TB.